

CORN as an Industrial Feedstock

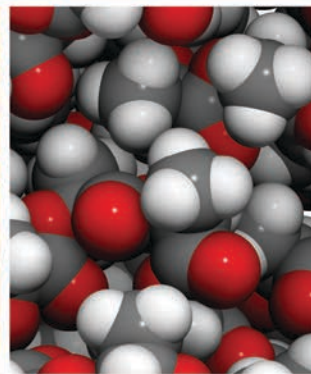


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Fast Facts about Corn as an Industrial Feedstock

Corn is a versatile feedstock with myriad uses. It represents an abundant, economically and environmentally competitive crop to use for bioproducts. The National Corn Growers Association strategic plan calls for increasing demand while enhancing productivity and environmental sustainability. Specifically, NCGA is committed to establishing new uses of corn and demonstrating corn as the clear feedstock of choice.



Corn is Sustainable

Sustainability and continuous improvement is important to corn farmers. Being able to pass the farming operation and land to the next generation is a priority. Since 1980:

- **Soil loss per bushel of corn has decreased by 68 percent.¹**
- **Corn production has seen a 36 percent decrease in greenhouse gas emissions per bushel.**
- **The energy used to produce a bushel of corn has decreased by 44 percent.**



Corn is Abundant

In 2019, there were more than 1.8 billion bushels of U.S. corn ending stocks. Thanks to technology advancements, farmers are able to produce more with fewer inputs than ever before. That means there's a lot of feedstock that is commercially viable and ready to be utilized for new uses.

- **Since 2000, corn production is up 4.7 billion bushels, average yields have grown by nearly 40 bushels/acre, U.S. total corn production is up 47 percent and corn yields have increased by 29 percent.**

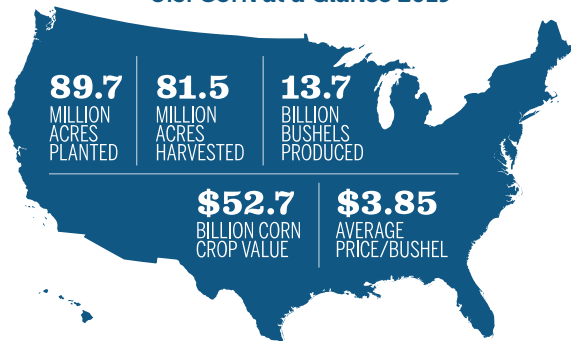


Corn is Affordable

Corn is an efficient and economically viable choice as a feedstock for biobased products. Improvements in technology, production and logistics have positioned corn as the smart feedstock choice for the next wave of innovation.

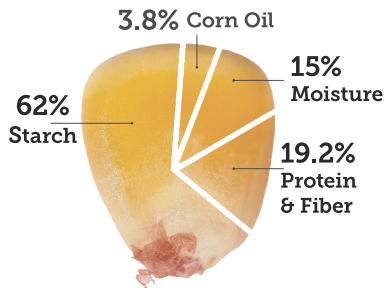


U.S. Corn at a Glance 2019



There are three types of corn: field corn, sweet corn and popcorn. Field corn makes up more than 99 percent of all corn acres in the United States. The corn kernel can be broken down into different components, which makes corn versatile enough to be in a wide array of products!

One bushel of corn is equal to 56 lbs. or 25.4 kilograms.



Here's a breakdown of the average composition of a kernel of corn:

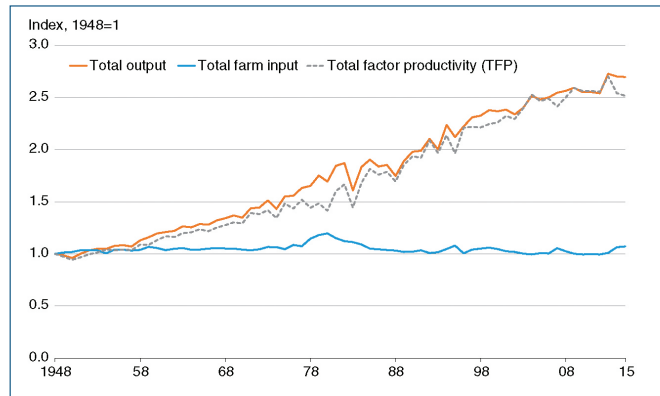
Per the February 2020 USDA World Agriculture Supply & Demand Estimates report, approximately 35 percent of corn is used for animal feed, 8 percent for Dried Distillers Grains with Solubles (DDGS), 26 percent for fuel ethanol, 11 percent for exports, and 9 percent for food and industrial, with 12 percent as surplus remaining.

Corn is a Responsibly Produced Industrial Feedstock

Advancements in technology and farming practices have changed dramatically over the years, making it possible for farmers to produce more on substantially less land by using fewer inputs. According to the United States Department of Agriculture Economic Research Service, **“total agricultural output nearly tripled between 1948 and 2015— even as the amount of labor and land (two major inputs) used in farming declined by about 75 percent and 24 percent, respectively.”**²

For every one unit of agricultural output in 1948, we have nearly three units today using only 7 percent more inputs.

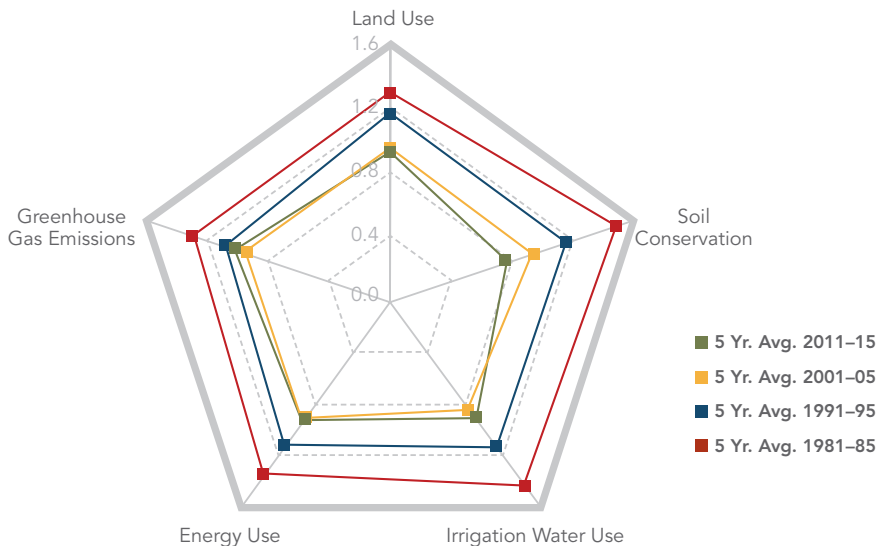
U.S. Agricultural Productivity Growth Accounts for Most Output Growth Between 1948 and 2015



Note: Data are expressed with an index that is calculated relative to the data in 1948, where data in 1948 are set to equal 1.

Source: USDA, Economic Research Service, *Agricultural Productivity in the U.S. data series.*

Indicators of Resource Use Impacts to Produce Corn for Grain



Corn is committed to sustainability. The chart above shows from 1980 – 2015 continuous improvements, increased efficiency and resource impacts for land use, soil conservation, irrigation water use, energy use and greenhouse gas emissions. While corn has achieved significant efficiency gains and improvements in sustainability, NCGA and corn farmers remain committed to continuous improvement in the future.

Source: *Field to Market's most recent Environmental and Socioeconomic Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States* (www.fieldtomarket.org/report)

Corn is a Responsibly Produced Industrial Feedstock



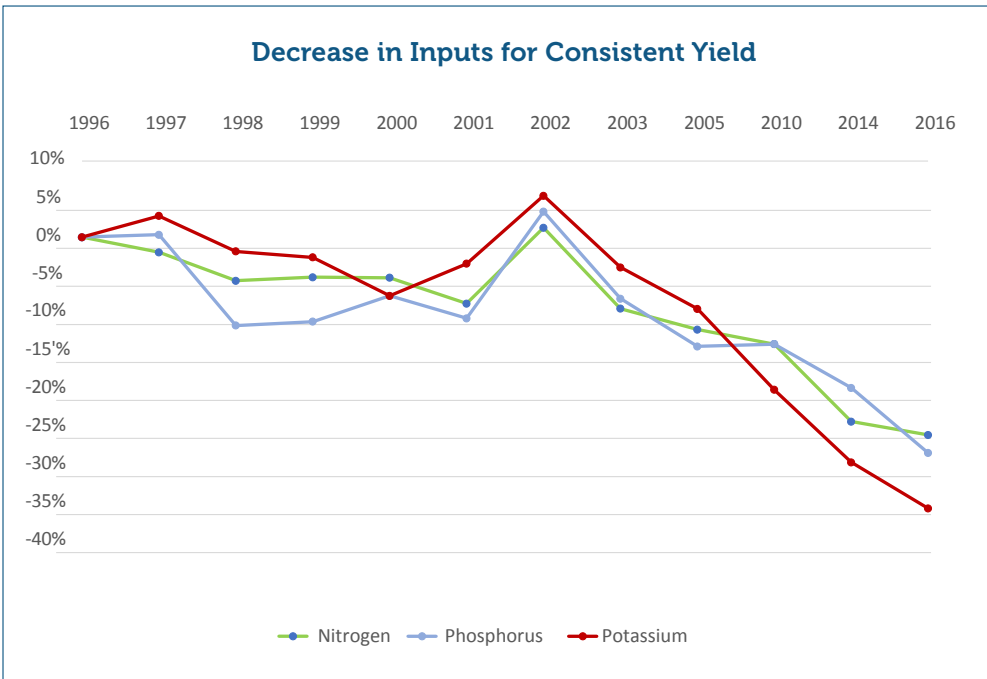
As new technologies are introduced, corn plants can do more with less. Nitrogen, potassium and phosphate are traditionally applied to the ground where corn is grown throughout the year at various times, depending on environmental factors and plant needs. These are all essential nutrients for the corn plant to thrive during the growing season. These nutrients complement each other, as potassium improves the yield response to nitrogen efficiency and phosphate helps maintain soil pH levels.

Growers have good reasons, both environmental and economical, to use nutrients efficiently. The chart to the right shows that over the past 20 years growers have reduced the usage of nitrogen, phosphorus and potassium by 26, 28 and 35.6 percent respectively for each bushel of corn produced.

Growers are committed to using these essential nutrients as efficiently and sustainably as possible, protecting the environment. NCGA and our state partners are committed to improving sustainability through the Soil Health Partnership and advancing solutions that improve water quality through reducing nutrient loss and reducing greenhouse gas emissions.

Thanks to advancements in corn breeding technology, farmers are producing more with less. Technology helps the corn plant be able to handle more stress and become more efficient while also increasing yield. Additionally, technology has also helped farmers be very prescriptive when applying nutrients to their crop. Advanced digital tools help farmers know exactly how much of each nutrient and when throughout the year it should be applied so there is minimal waste.

We are reducing inputs while increasing output.



Corn is an Abundant Industrial Feedstock

In 2019, corn farmers grew 13.7 billion bushels, or 350 million tons, of field corn. Thanks to technology, farmers continue to produce more per acre on less land using fewer inputs. There were more than 1.8 billion bushels, or 46 million tons, of U.S. corn ending stocks, meaning that's unused corn that could be utilized for a new use. **Despite the many uses of corn, on an annual basis we consistently have plenty of corn left over every year for food products, animal feed, fuel and other uses.**



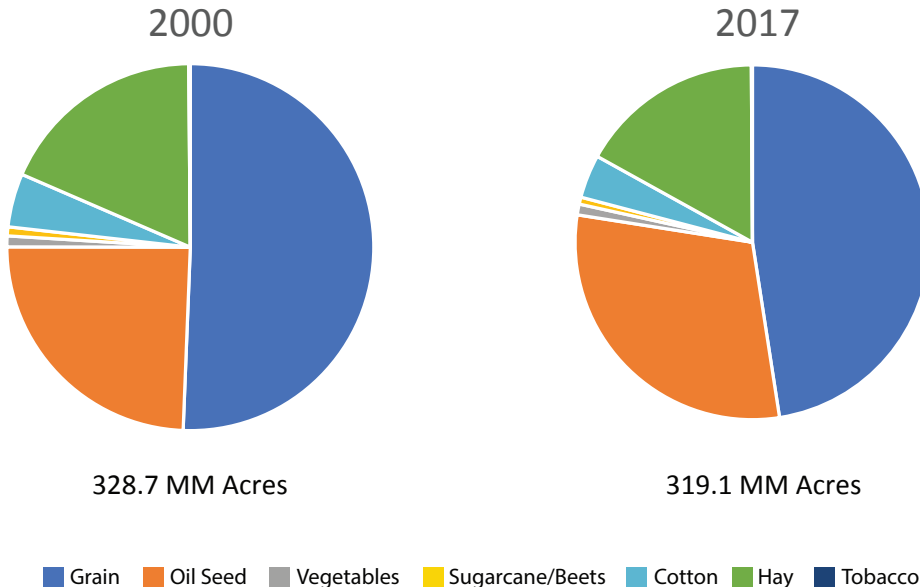
SINCE 2000

- Corn production up 4.7 billion bushels
- Average yields have grown by nearly 40 bushels/acre
- U.S. total corn production is up 47 percent and corn yields have increased by 29 percent

Since 2000, overall total U.S. field crop acres were down 9.5 million acres in 2017.

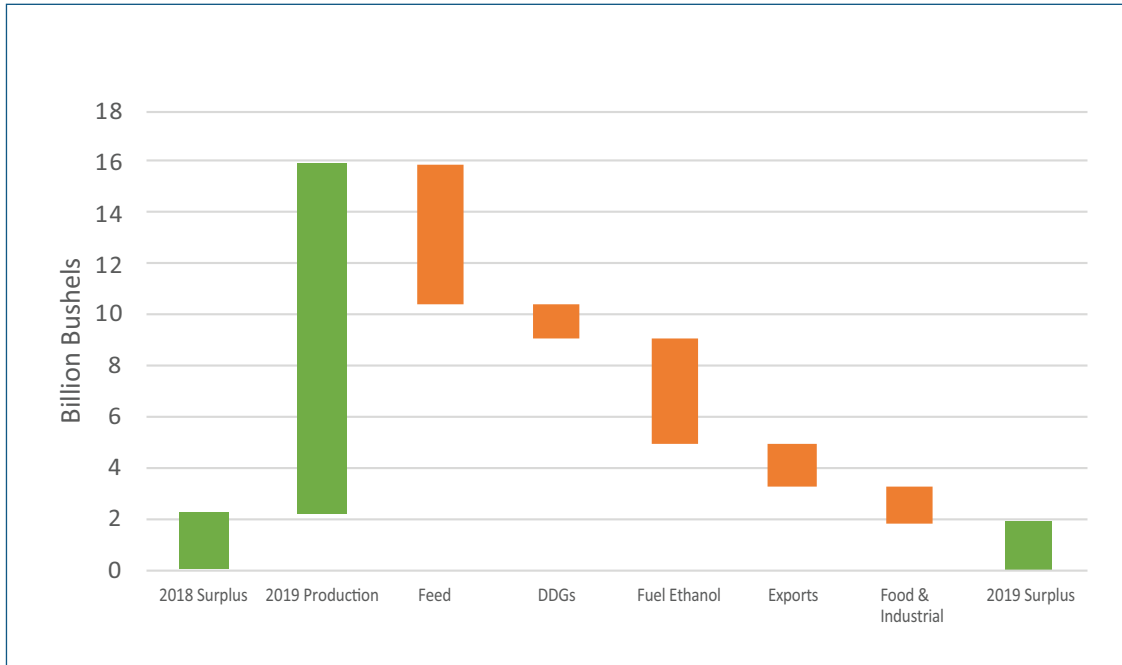
Total crop acres have decreased while output has increased, with corn acres up 10.6 million acres, due to the shift in crop production on the same acres already in production. Wheat, hay, sorghum, barley, cotton, oats and sunflowers are down 36.2 million acres during that time. Farmers alter planting decisions yearly based on market factors, weather and input costs.

Total crop acres have decreased.



Corn is an Abundant Industrial Feedstock

Corn Production and Usage 2019



Per the February 2020 USDA World Agriculture Supply & Demand Estimates report, approximately 35 percent of corn is used for animal feed, 8 percent for Dried Distillers Grains with Solubles (DDGs), 26 percent for fuel ethanol, 11 percent for exports, and 9 percent for food and industrial, with 12 percent as surplus remaining.

There are misconceptions that the use of corn for ethanol impacts land use and food prices. That is simply not the case. On average one bushel of corn (56 lbs.) processed by a dry mill ethanol biorefinery produces: 2.86 gallons of denatured fuel ethanol; 15.9 lbs distillers grains animal feed (10 percent moisture); 0.75 lbs. corn distillers oil and 16.5 lbs. of biogenic carbon dioxide.³ A study published in the journal *Biomass and Bioenergy* walks through food price and land use data⁴. Some highlights from the study include:

- **Real-world data showed no evidence of food price increases or other lands converting to agriculture because of biofuel.**
- **Due to increasing per capita food production, U.S. food price inflation has seen no change since 1991 despite the biofuel boom.**
- **Automated land use classification errors were biased towards classifying ambiguous land as agriculture.**
- **U.S. and world agricultural land decreased at 5,900 and 56,500 sq. km. each year respectively between 2000 and 2015.**
- **Crude oil price and world population were the two most significant factors affecting the world food price index.**
- **Per capita, food production in the U.S. and world are rising.**

Corn is an abundant, versatile and reliable feedstock source that can support not only food, fuel and feed but a variety of unexpected products as well, many of which you use every day!

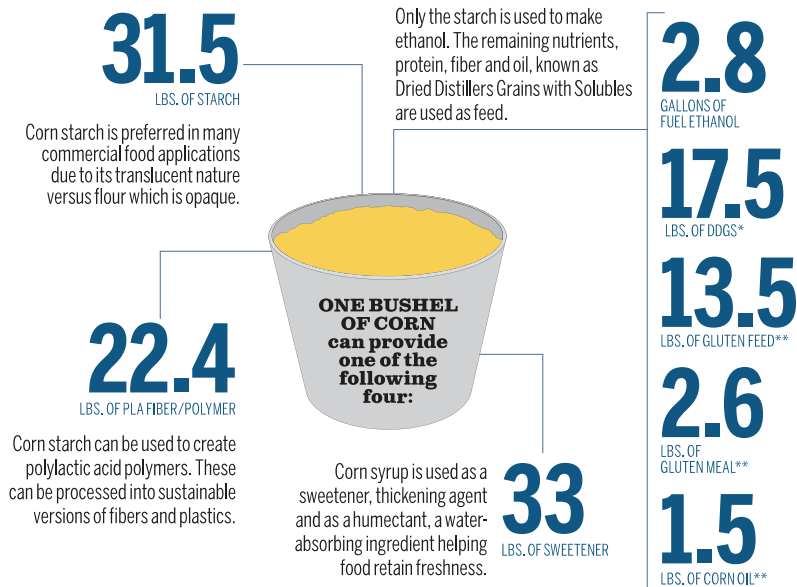
Examples include cosmetics and deodorant, baby food, crayons, low-fat yogurt or frozen pizza. With the increased demand and interest in greener chemicals and biobased products, the potential for field corn to be utilized is endless!



Corn Meets Societal Needs

Corn as its components is worth more than whole corn—therefore corn processing creates value.

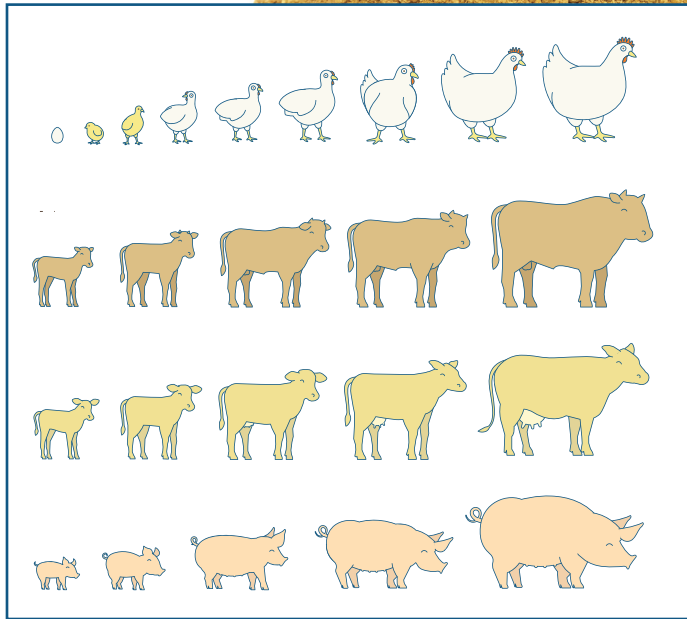
Today, dry mill corn ethanol produces three valuable products—2.8 gallons of ethanol from starch, 1.2 pounds of oil for feed or fuel, and 17.5 pounds distiller's dried grains (DDGS) for animal feed. This process creates significant animal feed. From October 2018 to September 2019, more than 48 million tons of high protein feed was produced.



*In dry-grind ethanol process.

**In wet-mill ethanol process.

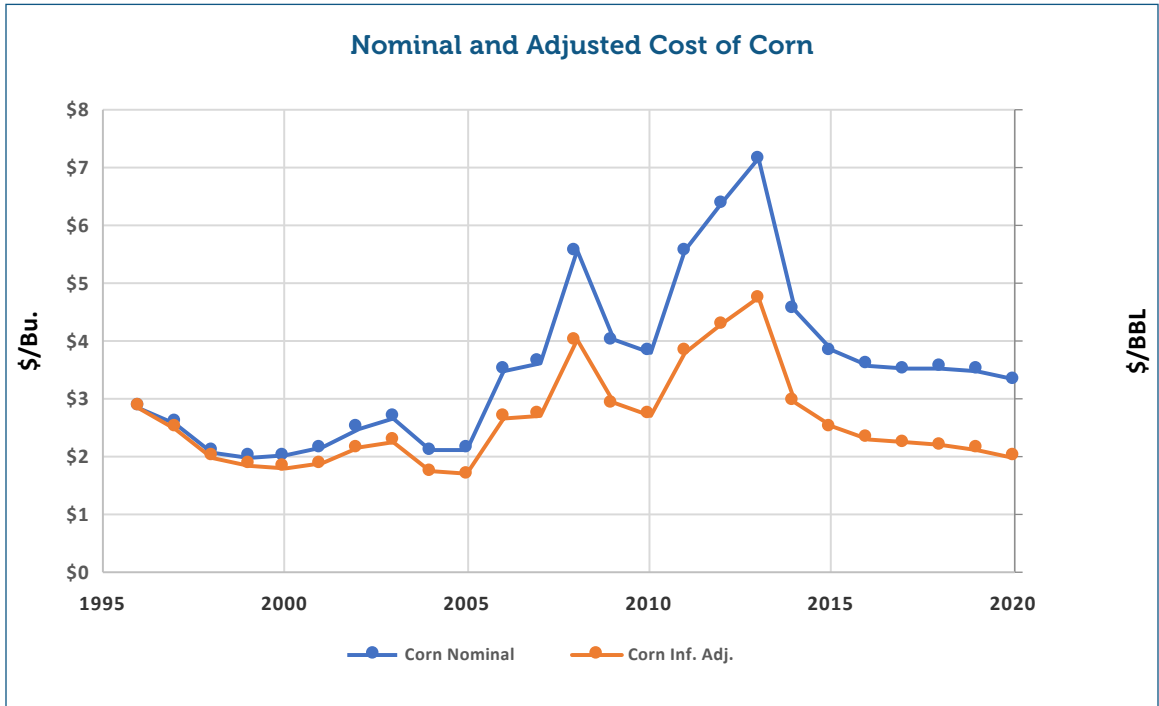
Gluten feed is 20 percent protein and gluten meal is 60 percent protein.



Drymill plants are beginning to implement innovative separation technologies which will further increase the quality of co-products from the plant. These next generation co-products will allow animal nutritionists to optimize diets for specific species at specific stages of life. Further, by adding exactly what the animal needs to grow, undigested nutrients should decrease, enhancing sustainability across the entire system.

Corn is an Affordable Industrial Feedstock

Corn's cost as a feedstock has benefited greatly by improvements in technology, production and logistics efficiency. Corn price, when adjusted for inflation, is near its all-time low.



As can be seen in the chart to the left, corn was affected by the 2008-13 commodity super cycle, which impacted a wide range of commodities from oil to metals. Since that time, however, corn prices have moved back to more historic levels. It should be noted, that price has returned to normal levels, despite the growth of nearly 5.6 billion bushels of new demand of corn-based ethanol.

U.S. corn farmers continue to produce a high quality and reliable crop each year.



NCGA is committed to increasing opportunities for growers by stimulating demand.

Who We Are

Founded in 1957, the National Corn Growers Association represents nearly 40,000 dues-paying corn farmers nationwide and the interests of more than 300,000 growers who contribute through corn checkoff programs in their states. NCGA and its 50 affiliated state organizations work together to create and increase opportunities for corn growers.

Our Mission

Create and increase opportunities for corn growers

Our Vision

Sustainably feed and fuel a growing world

Learn more about NCGA and our initiatives by visiting our website at ncca.com/newuses.

Contact us today on how we can help you use corn as a feedstock for your product!

Sources

- 1 <https://www.ers.usda.gov/topics/farm-economy/agricultural-research-and-productivity/>
- 2 <https://www.ers.usda.gov/amber-waves/2018/march/agricultural-productivity-growth-in-the-united-states-1948-2015/>
- 3 <https://ethanolrfa.org/wp-content/uploads/2019/02/RFA2019Pocket-Guide.pdf>
- 4 <https://ethanolrfa.org/wp-content/uploads/2020/02/2020-Outlook-Pocket-Guide-for-Web.pdf>



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