Perspectives on the Future of Ethanol and Co-products

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DGTC 28th Distillers Grains Symposium

November 13, 2024

DISTILLERS GRAINS TECHNOLOGY COUNCIL
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Today's Presentation

- A look at today's U.S. ethanol and co-products S&D
- Current market and policy issues
- What does the future hold for U.S. ethanol co-products?

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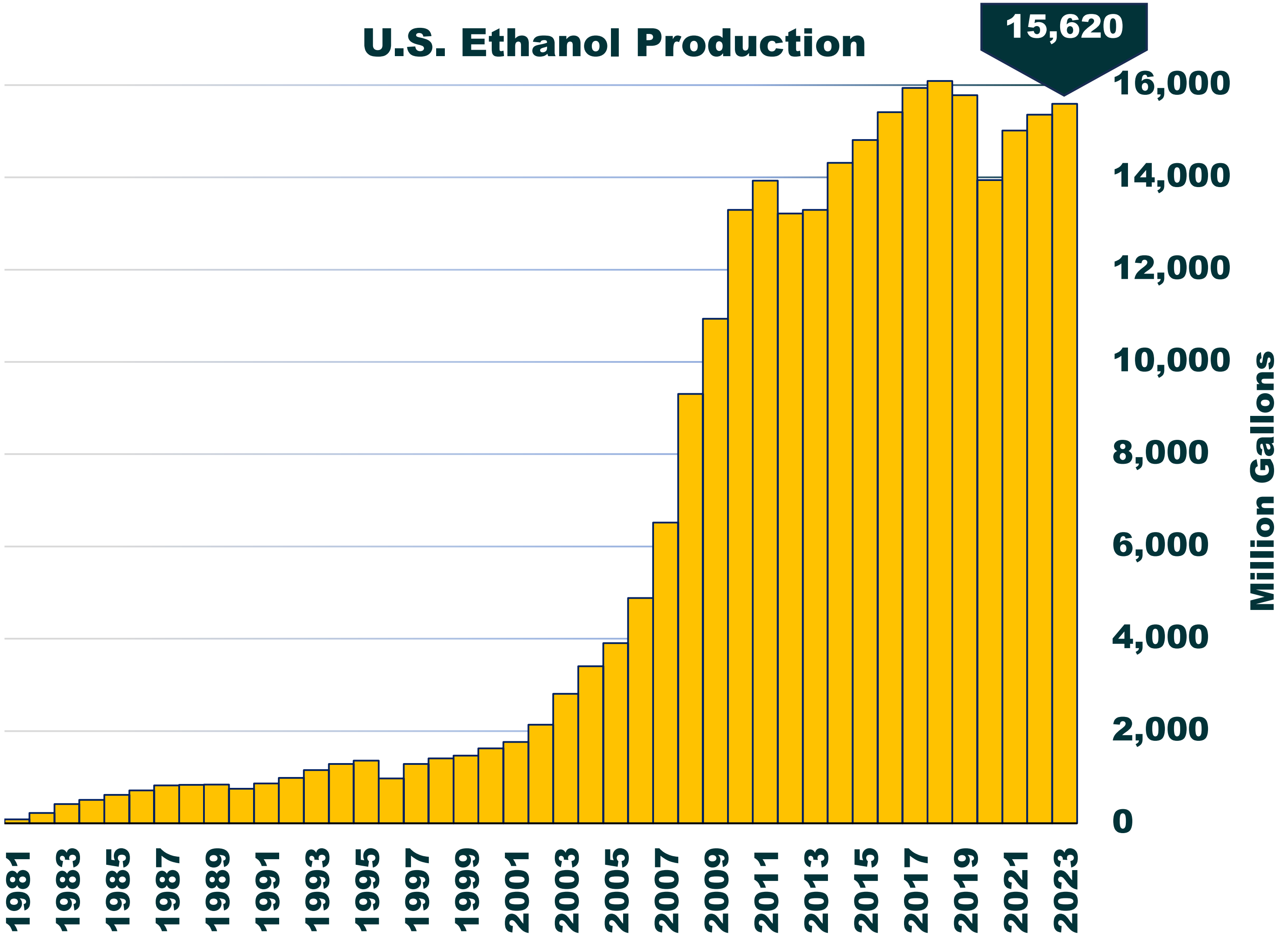
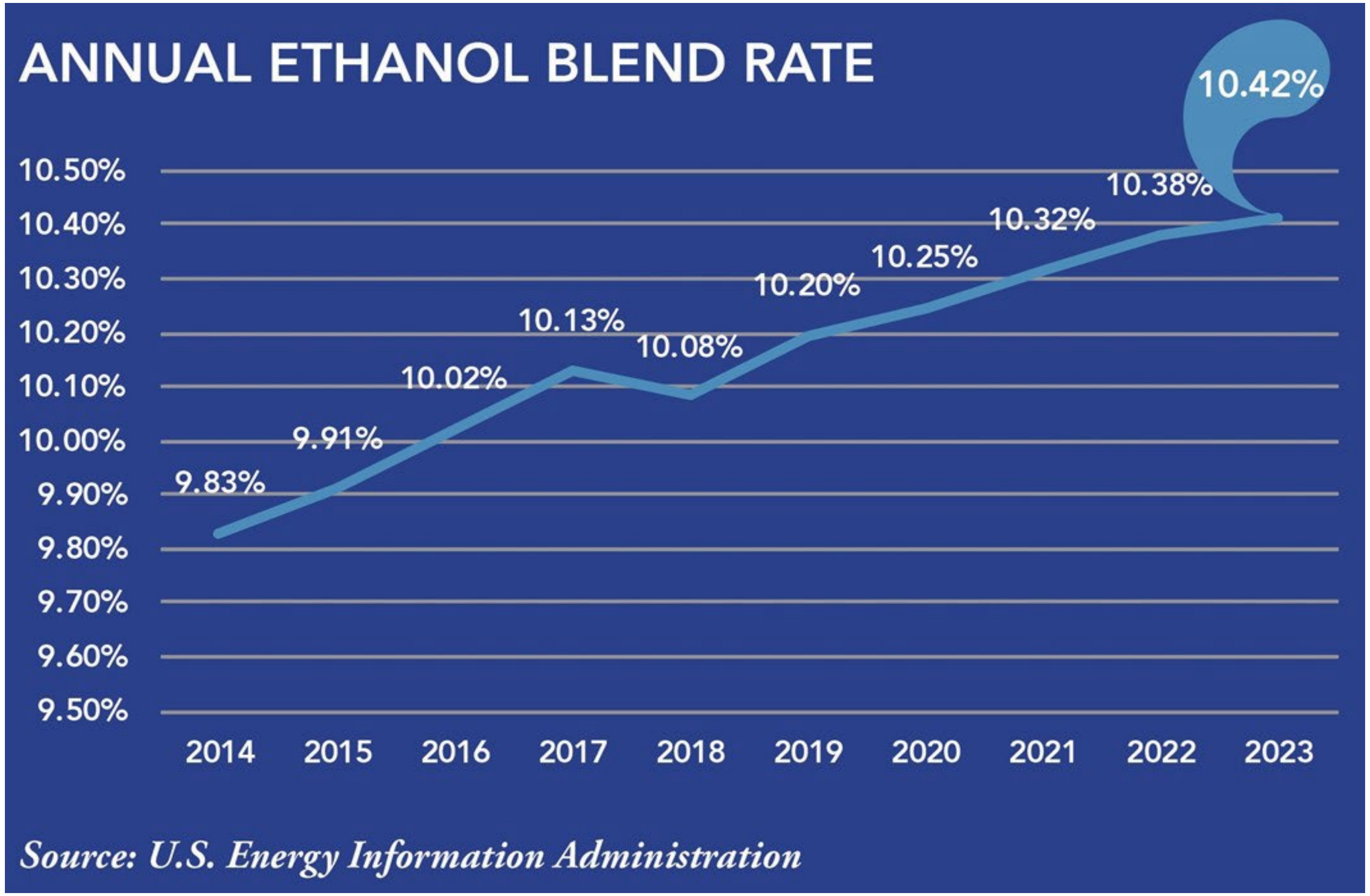
Co-product Supplies Depend on Ethanol Production Levels

- **200** biorefineries in **24** states with **18.1 billion gallons** of annual production capacity
- Record ethanol production expected in 2024—**16.0 bg** would be highest annual level since 2018
- Key demand drivers include:
  - Corn prices
  - Natural gas supplies
  - Profit margins
  - Capacity expansion and modernization
  - Policy certainty



U.S. Ethanol Demand



- U.S. ethanol consumption on track to reach **14.2 bg** in 2024, marginally lower than in 2023
- When the use of E10, E15, and flex fuels is averaged together, ethanol accounts for about **10.4 percent** of total gasoline volume.

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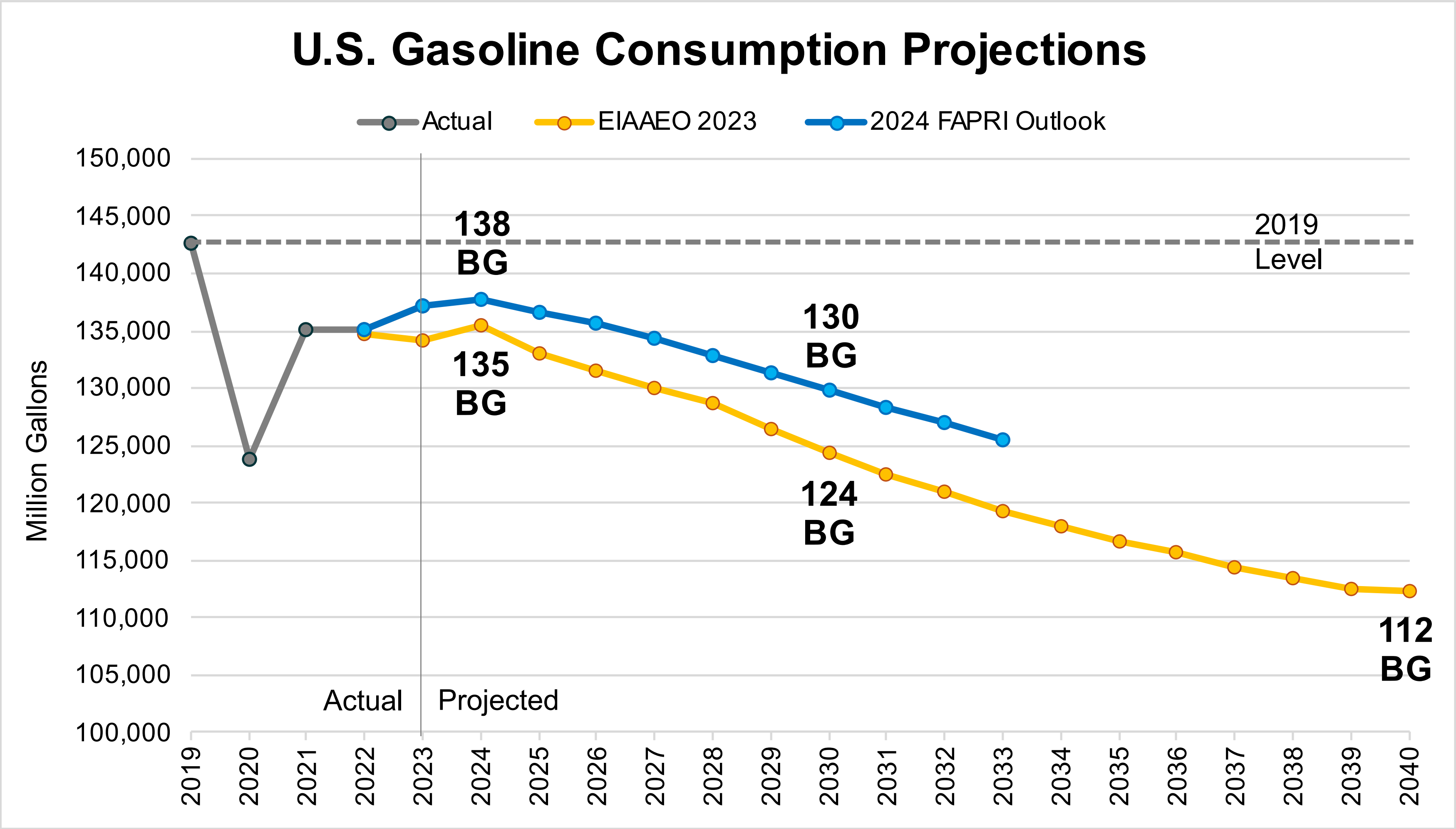
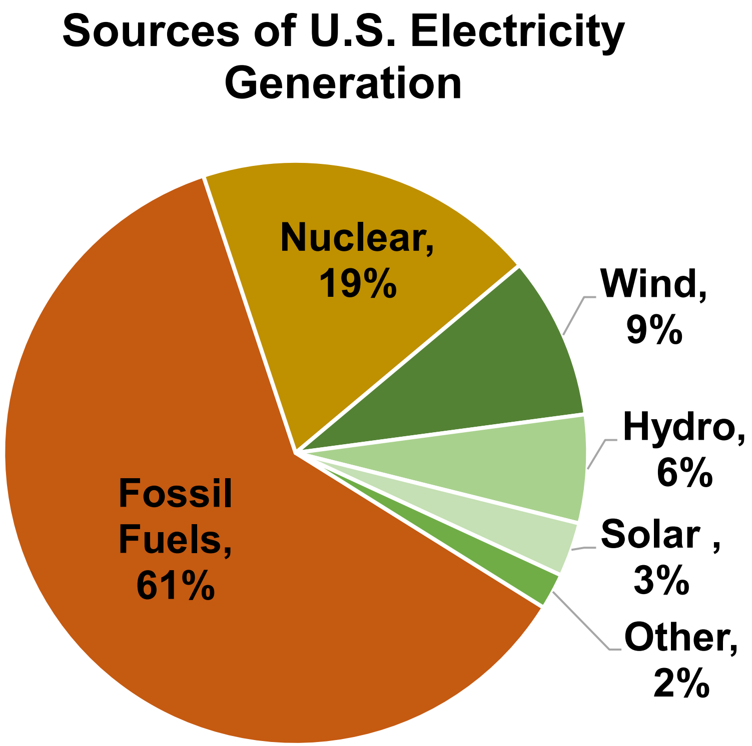
Ethanol Demand Remains Below Pre-Pandemic Highs



Gasoline demand has yet to return to former levels due to:

- **Fuel efficiency**
- **Electrification**

There is No Such Thing as a “ZEV”



Source: Energy Information Administration

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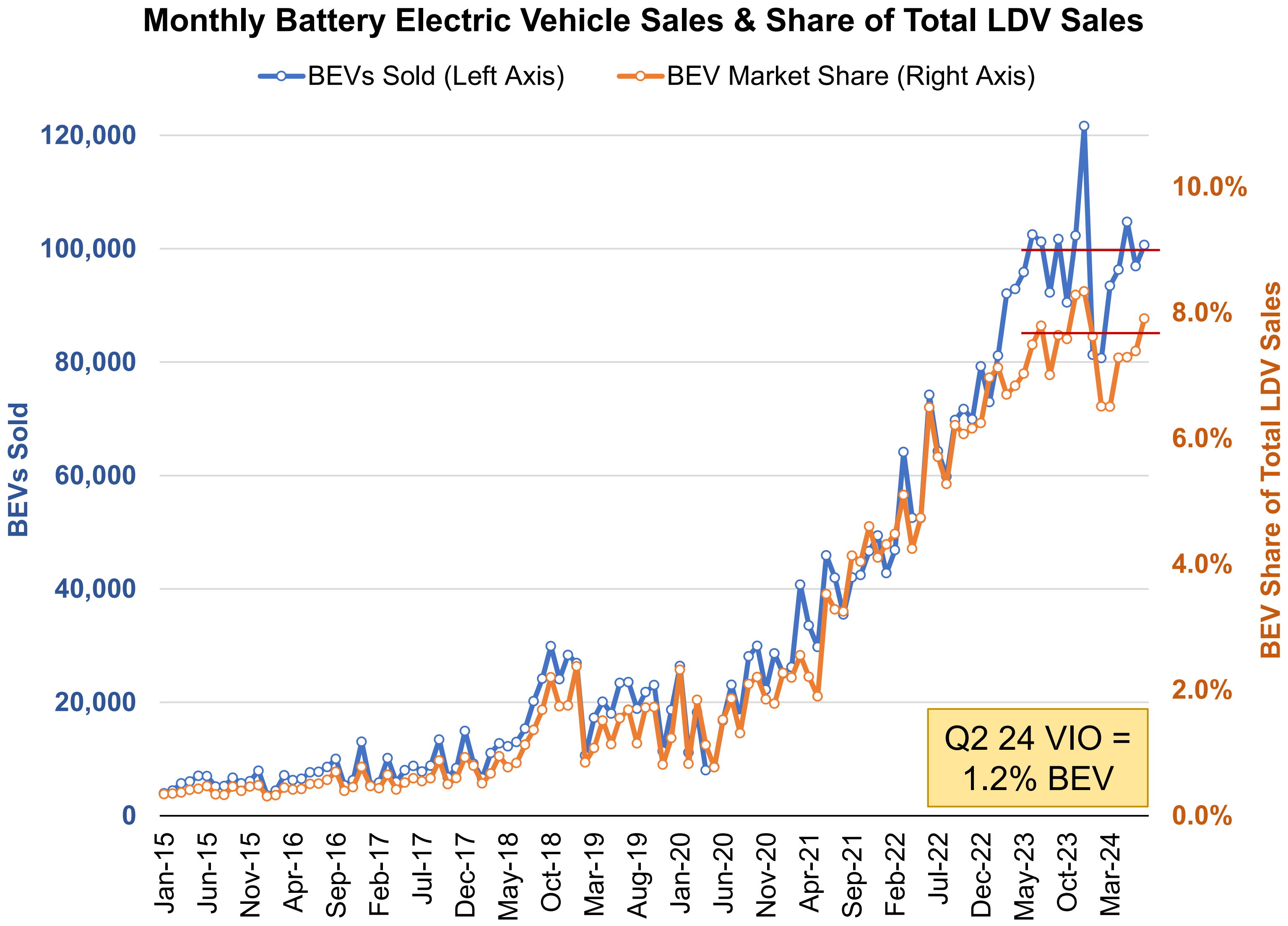
EV Sales Stalling?



Mercedes Is Walking Back Its All-EV Future to Invest in 'High-Tech Combustion'

Just a few years after "switching from EV-first to EV-only," Merc says it's throwing its weight behind further ICE development.

McKinsey: 46% of U.S. EV owners want to switch to ICE vehicles

Used EV Prices in Freefall

Dealers should plan to discount heavily to clear inventory, reports iSeeCars.

npr

EVs won over early adopters, but mainstream buyers aren't along for the ride yet

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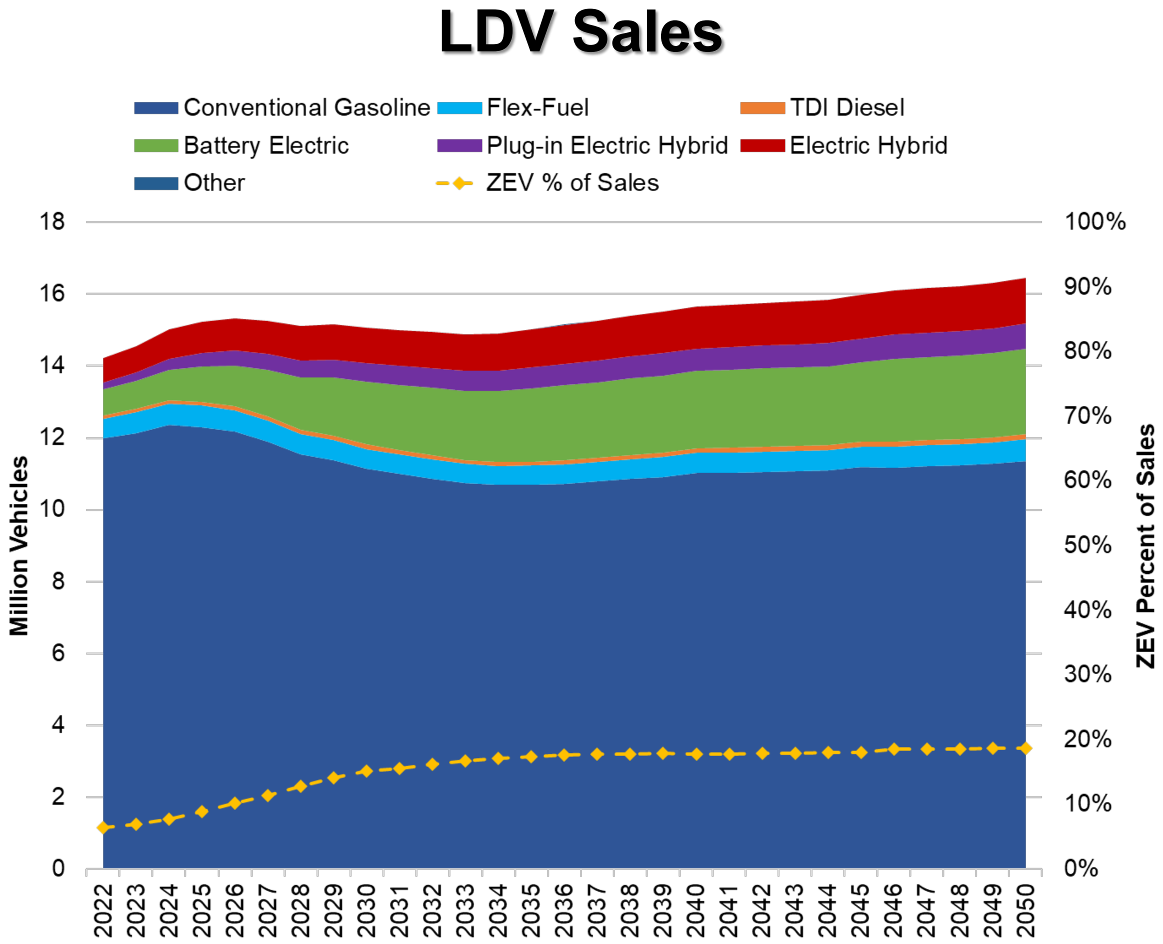
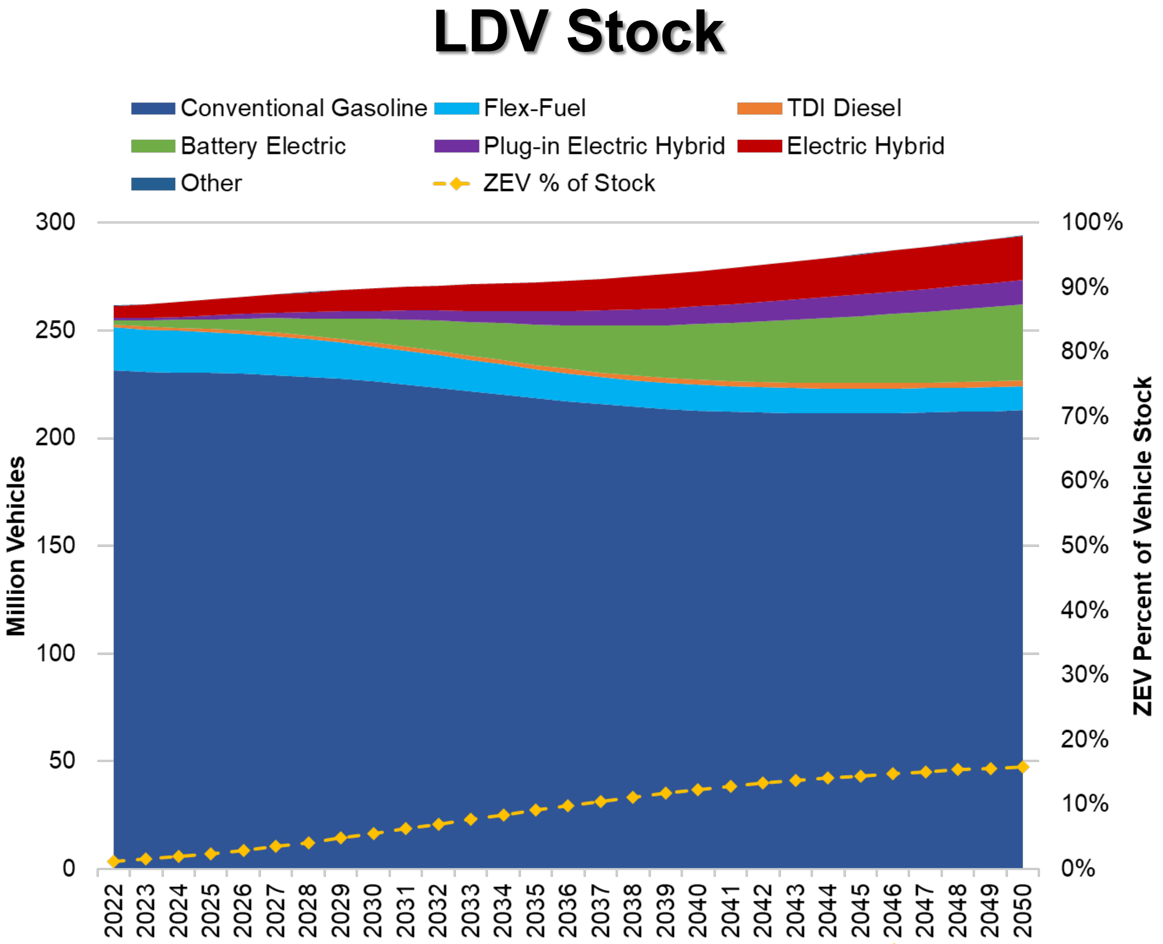
EIA Expects EVs to Make Very Gradual Inroads into LDV Sales and Stock





Source: Energy Information Administration, 2023 Annual Energy Outlook

Note: ***Appears not to incorporate California Advanced Clean Cars II*** regulation phasing out ICEVs (except PHEVs), since AEO reflects legislation and regulations as of mid-November 2022 and ACC II wasn't finalized until the end of November.

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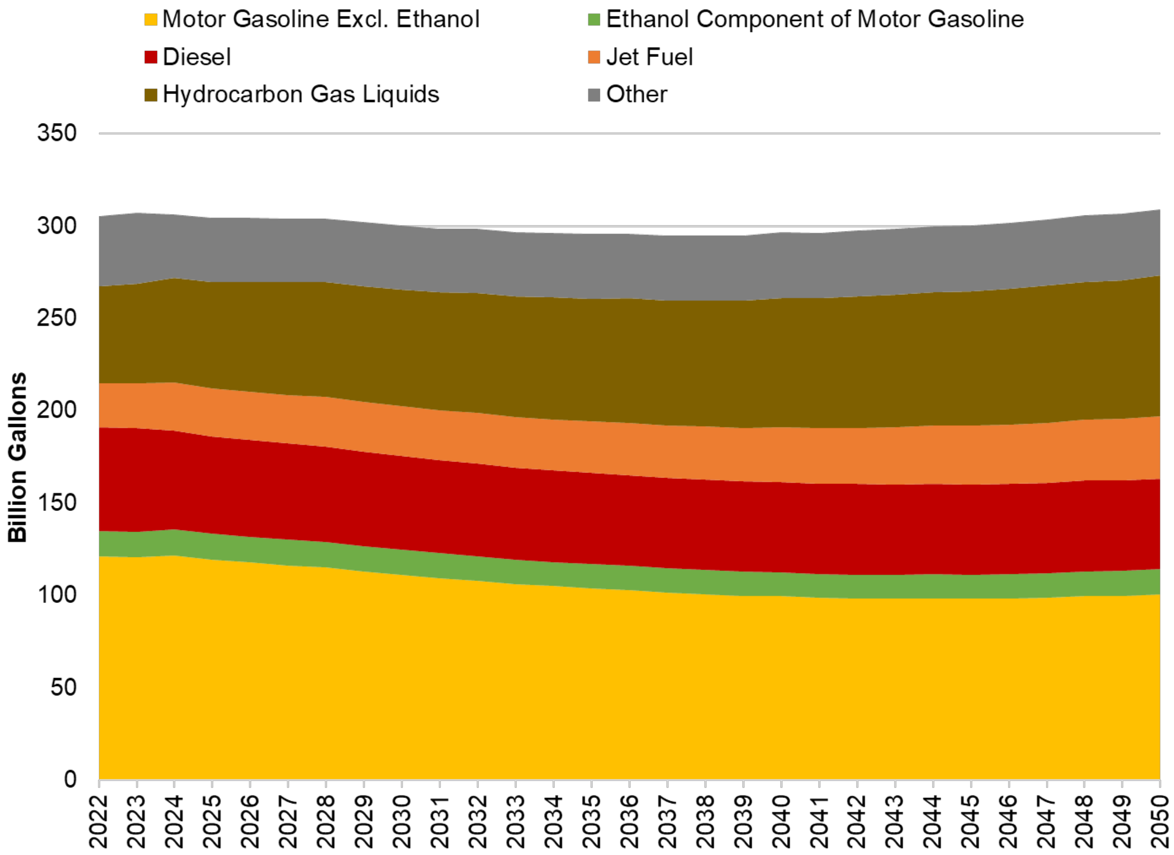
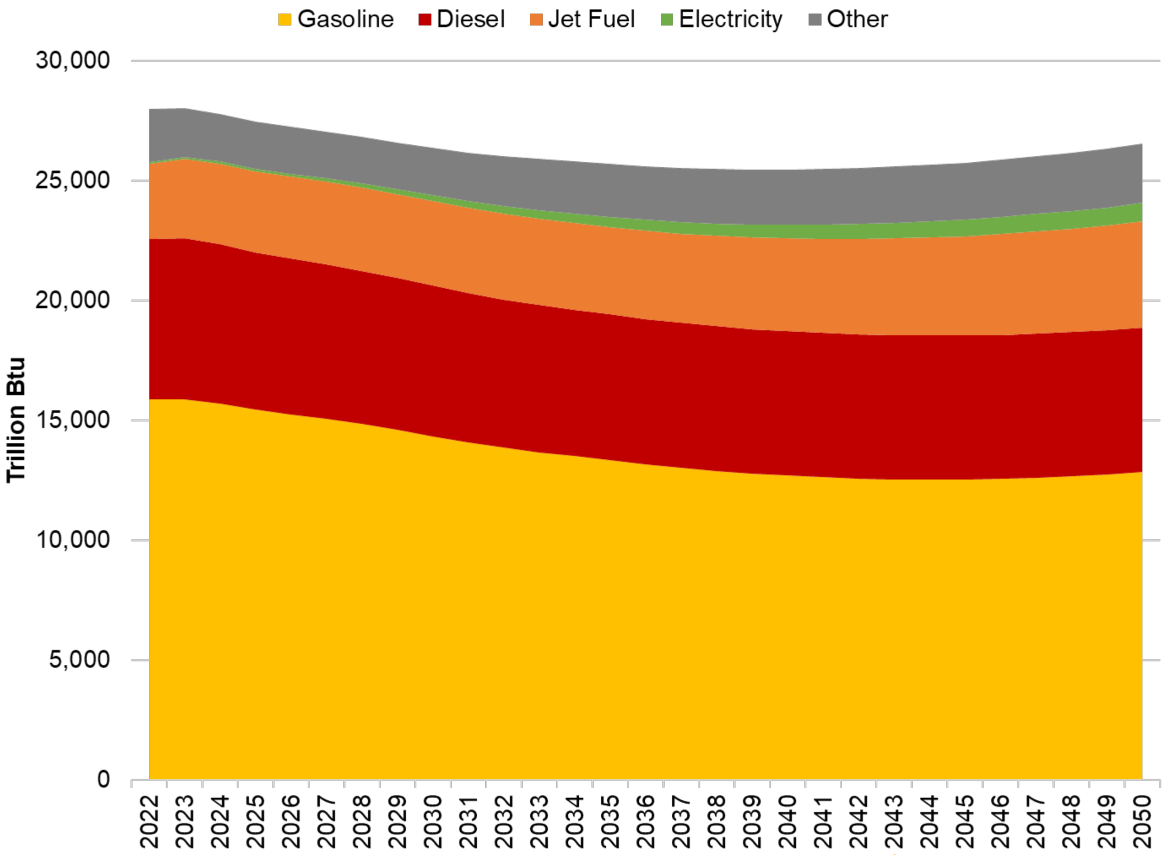
EIA Shows Robust and Generally Stable Liquid Fuel Use Through 2050

Product Supplied: Petroleum & Other Liquids



Source: Energy Information Administration, 2023 Annual Energy Outlook

Transportation Sector Energy Use by Source



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Sustainable Aviation Fuel

- SAF the most feasible way to reduce aviation emissions (10% of U.S. transportation GHGs)
- Attractive feedstocks: Ethanol, veg oils, animal fats
- Government policy (+ airline sustainability commitments) has created strong incentives for production and use
  - 40B/45Z/state tax credits
  - RFS opt-in, LCFS opt-in
  - SAF must reduce lifecycle GHG emissions by 50% compared to conventional jet fuel to qualify
- DOE's SAF Grand Challenge:
  - Achieve minimum 50% reduction in lifecycle GHGs
  - 3 bgy SAF production by 2030
  - 35 bgy SAF production by 2050

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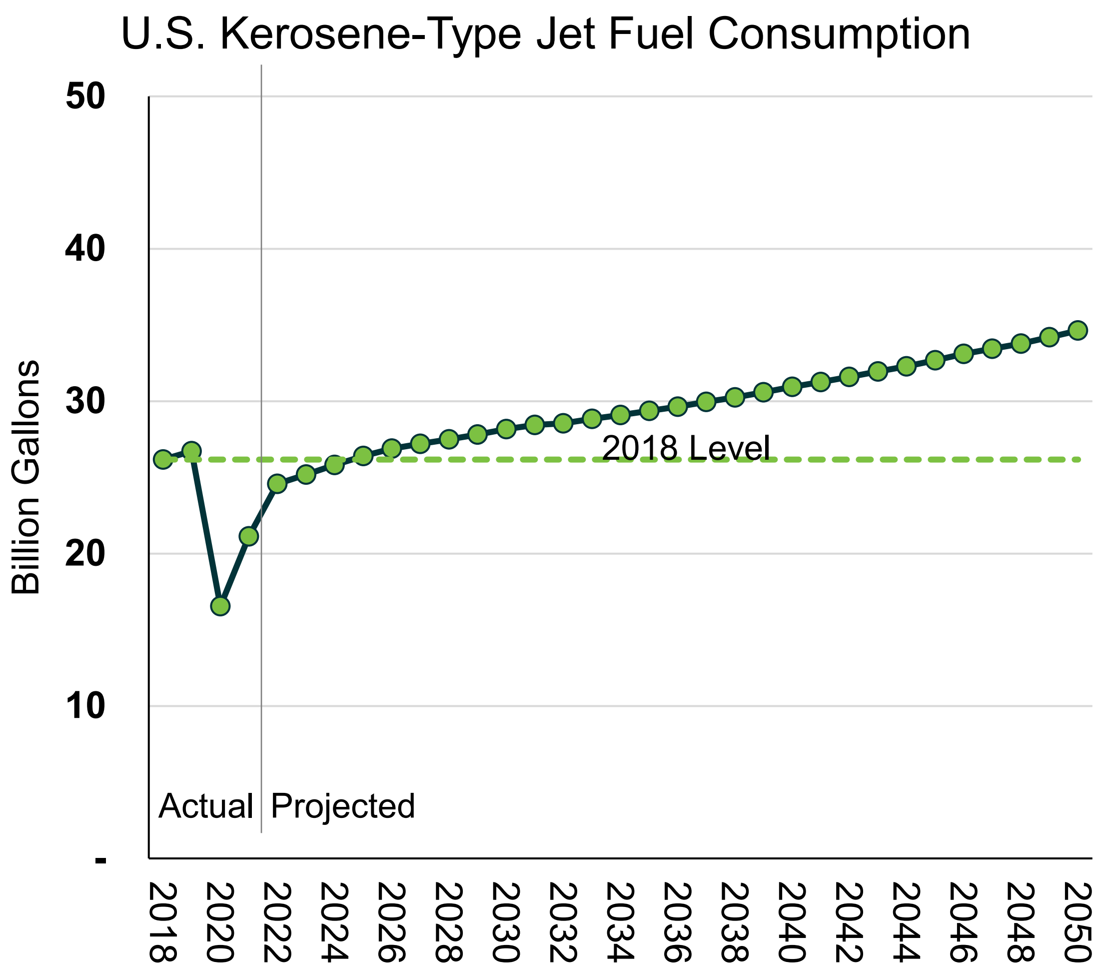
How Large an Opportunity is the Jet Fuel Market?



Source: Energy Information Administration

- U.S. demand expected to hit 30 bg by 2035 and 35 bg by 2050
- SAF typically blended at a 50:50 ratio with kerosene-type jet fuel
  - Equivalent to 15 bg of theoretical SAF demand by 2035
  - 1 gallon of SAF requires 1.6 gallons of ethanol (due to dehydration/oxygen removal)
- To meet **HALF** of the SAF Grand Challenge target for 2030, **roughly 2.4 bg of ethanol would be needed**

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SAF's Implications for Ethanol Co-products

- **Higher Animal Feed Output**: If all currently planned SAF projects reach full capacity, they will require **1.3–1.4 bgy** ethanol, which increases co-product production
- **Reduced DCO Availability**: Greater SAF demand may limit DCO availability for animal feed and biodiesel, affecting supply and prices
- **Low-Carbon Shift**: Ethanol plants adopting CCS or renewable energy can align DCO and co-products with sustainability standards
- **Distillers Grains Impact**: Increased DCO extraction creates higher-protein, leaner DGS, enhancing competitiveness with feeds like soybean meal
- **Export Market Shifts**: SAF-focused ethanol production may tighten global DCO and DGS supplies, impacting international markets

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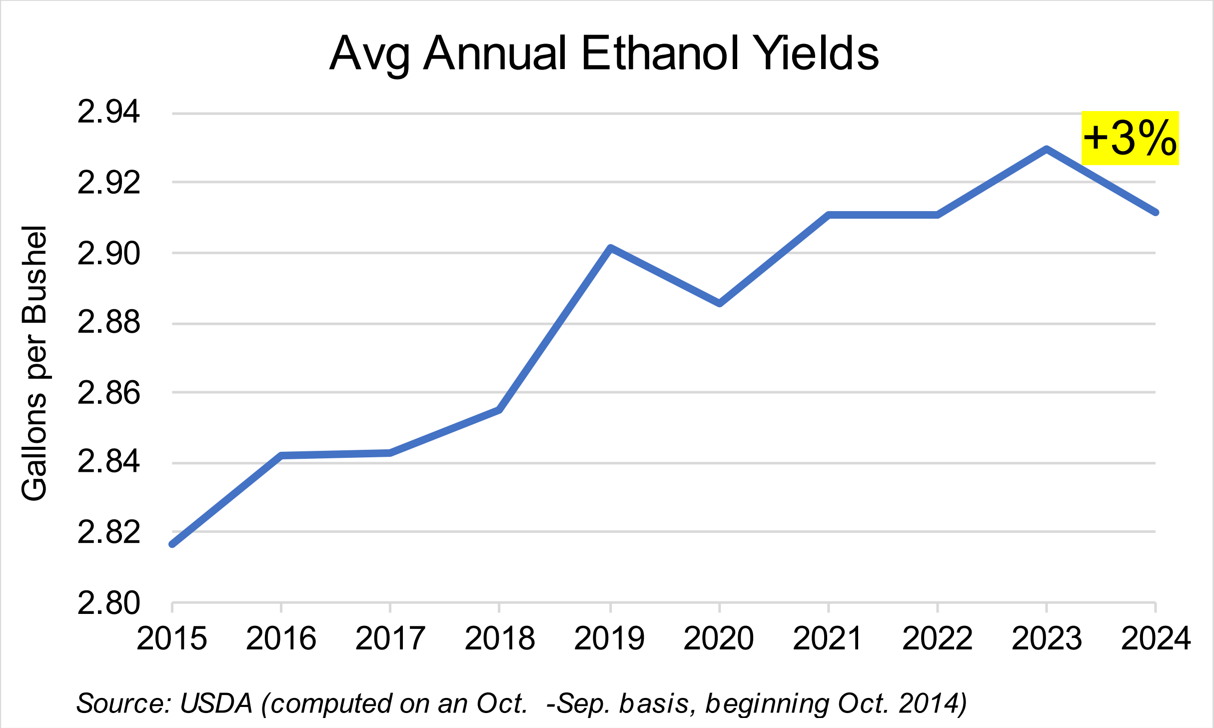
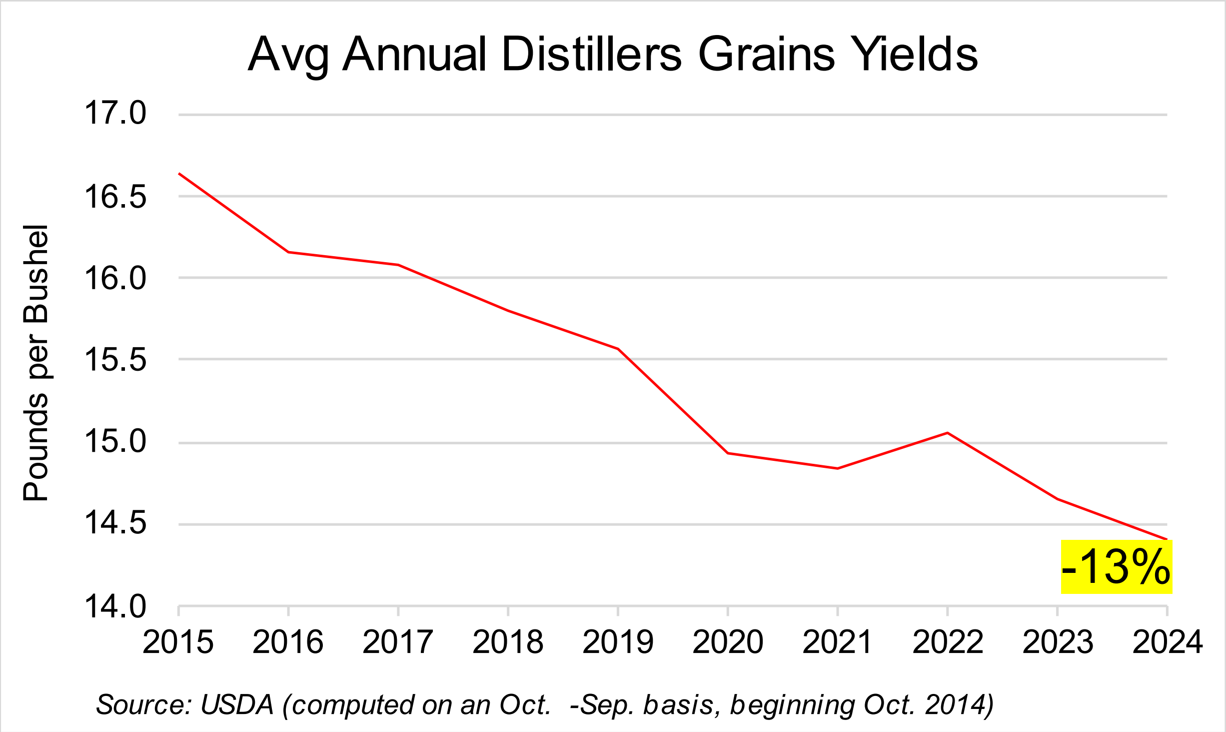
Reduced DGS Yield Reflects…





- Corn Oil Extraction
- Demand for Higher Protein Feeds
- Fermentation and Enzyme Efficiency
- Process Adjustments and Innovations for New Preferences

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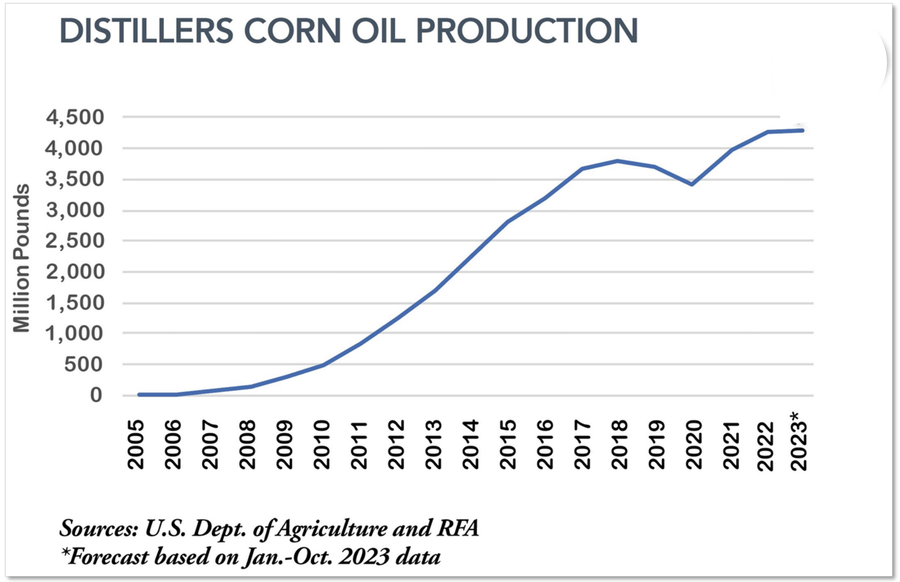
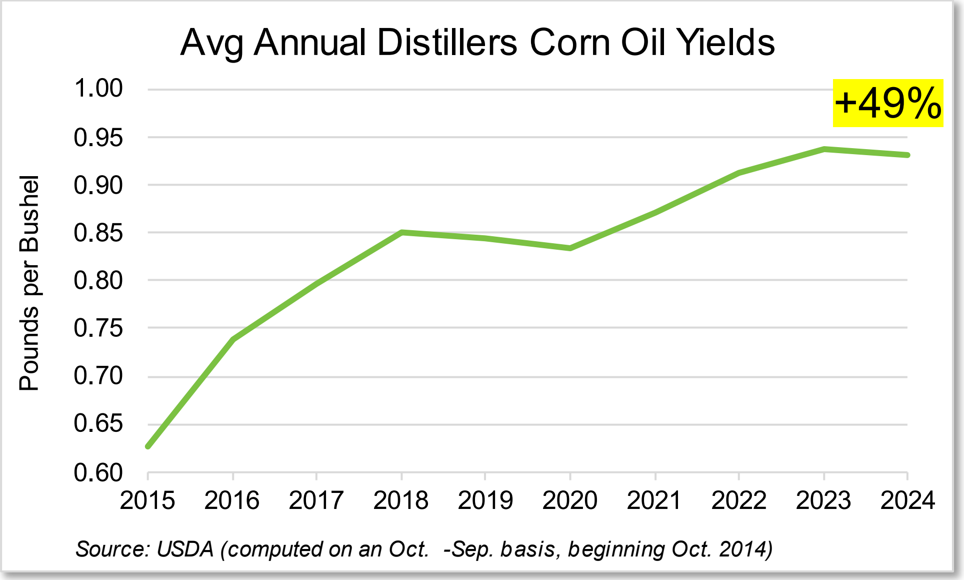
But…Extracting DCO is a Win-Win





- DCO for Biodiesel and Renewable Diesel Production:
  - 4.1 million lbs. in 2023
  - YTD 2024 supply 5% ahead of last year’s pace
- Additional Revenue Stream for Biorefineries
- Enhanced Protein Concentration
- Improved Digestibility
- Better Energy Utilization
- Reduced Risk of Rancidity

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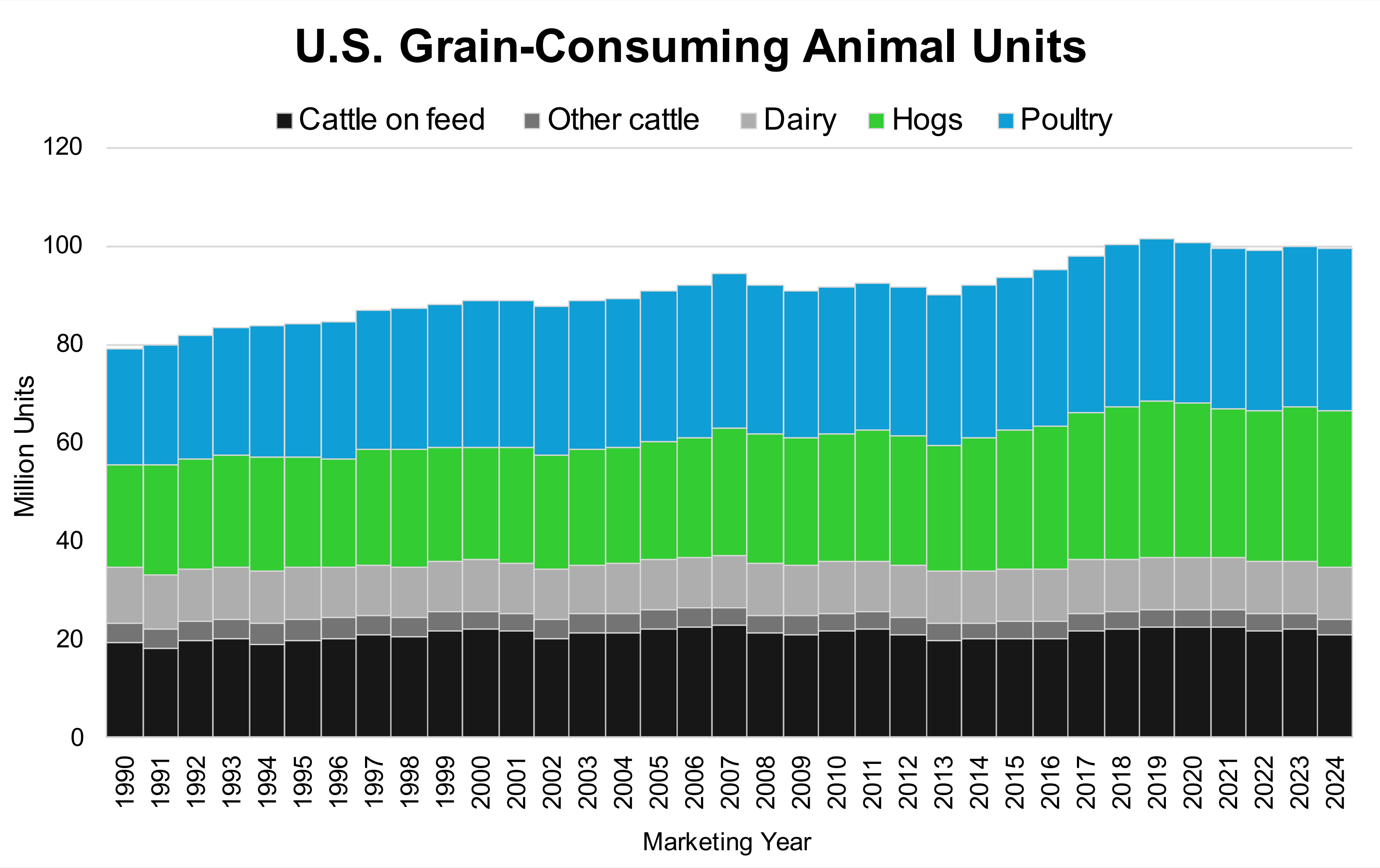
U.S. Co-product Demand:
Livestock and Poultry Inventories



Source: USDA

- MY 2024 total grain-consuming animal units: **2% lower than the record** number in MY 2019
- Poultry inventory: **Record high**
- Hogs: **Second-largest on record**
- Dairy: **11-year low**
- Cattle on feed: **8-year low**
- Other cattle (stockers, feeders, replacement heifers, bulls): **Record low**

1 GCAU Equivalencies

1.0 Dairy cow
0.65 Beef (on feed)
18.3 Other beef cattle
4.4 Hogs
46 Layers
500 Broilers
64.5 Turkeys

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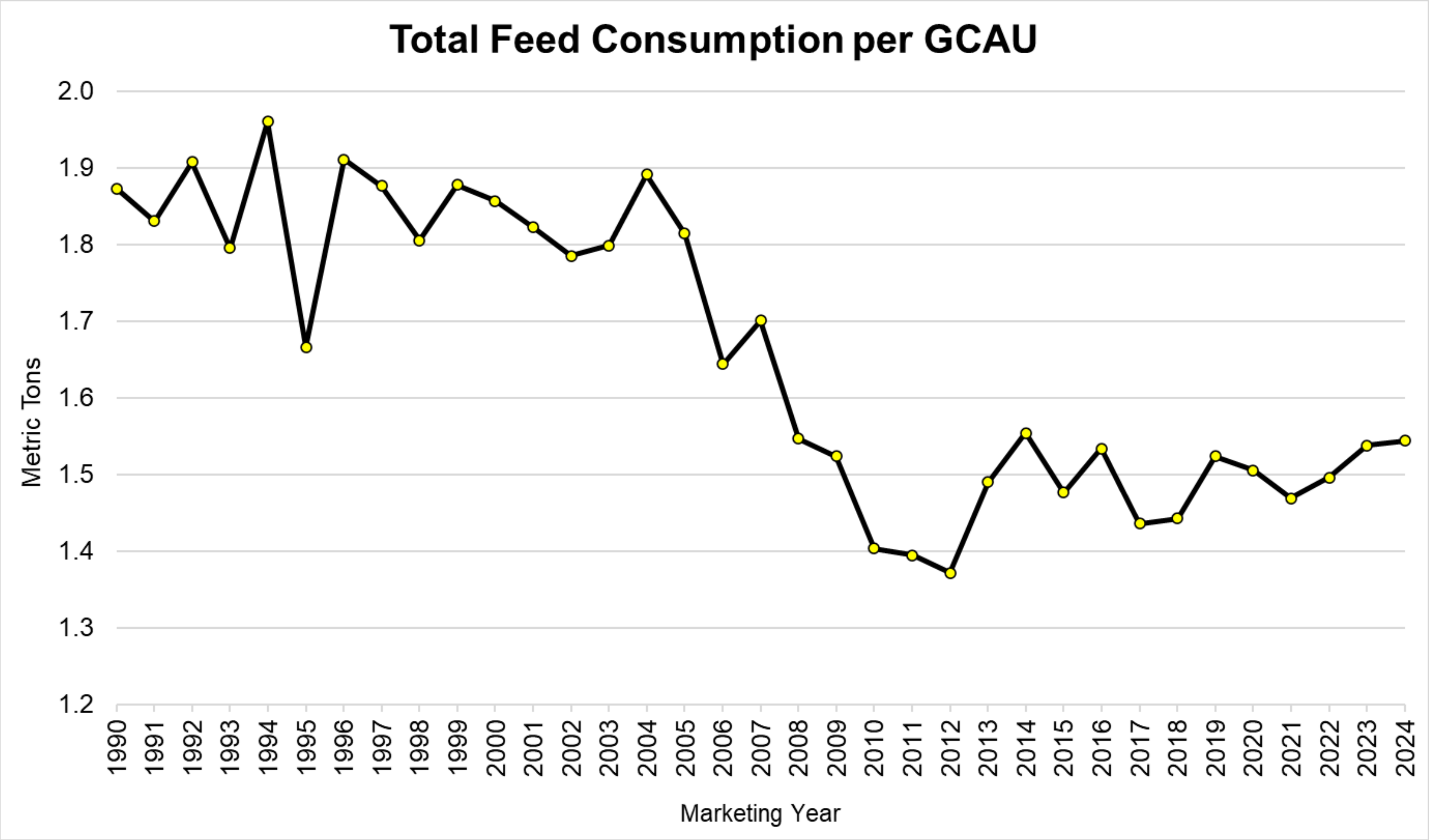
Trends in Feed Consumption per U.S. Animal Unit



Source: USDA

- Average energy and protein feed consumption per animal has declined 18% over the last two decades
- Consumption has been trending upward from the MY 2012 low
- MY 2024 feed intake is estimated at **1.5 mt per GCAU**

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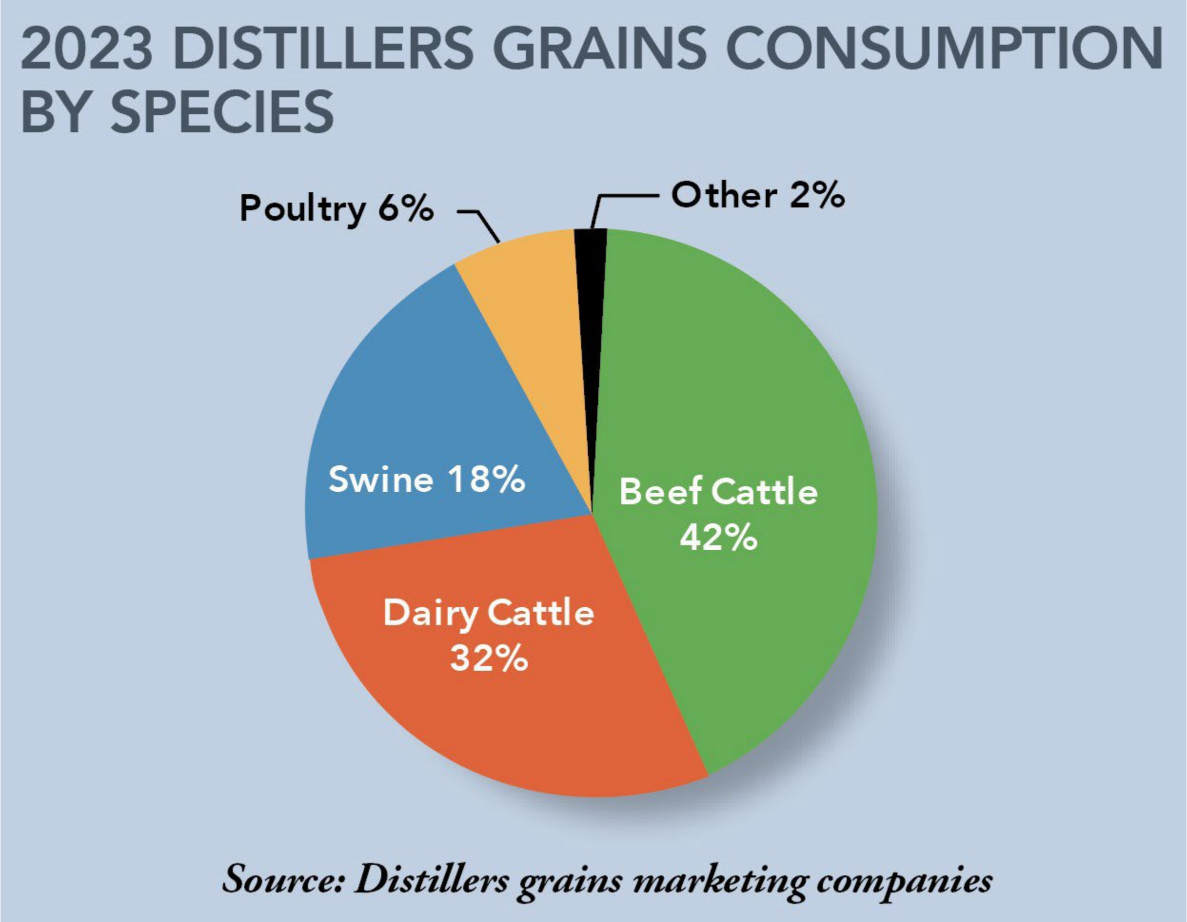
U.S. DGS Demand Remains Robust, Bolstered by Swine and Poultry Sectors Growth



MY 2025 projections

- Poultry inventories: **+11.5%**
- Beef cattle inventories: **+1.6%**
- Dairy inventories: **-0.1%**
- Hog inventories: **+0.3%**
- U.S. consumption of DGS: **+1.3%**

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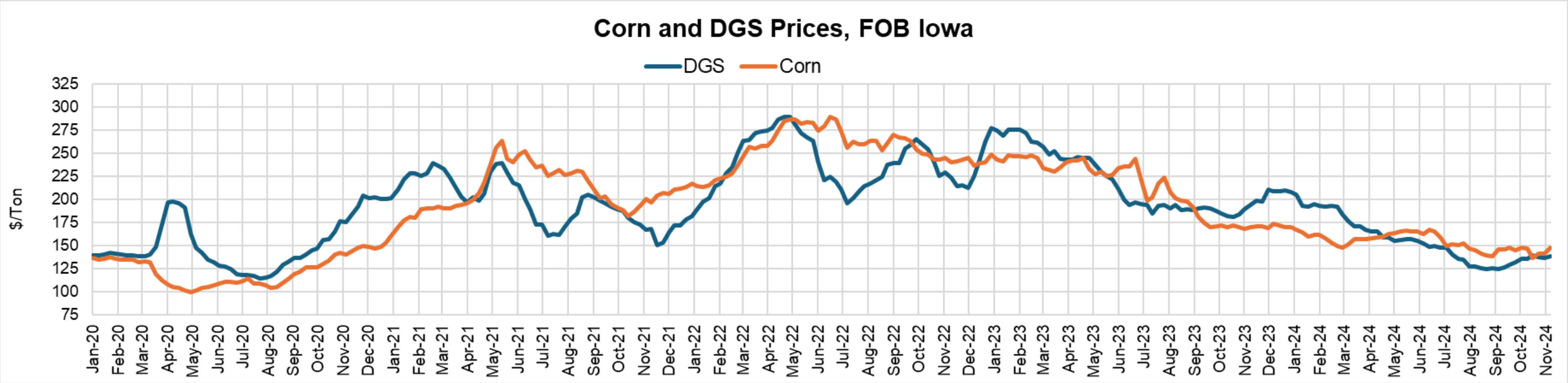
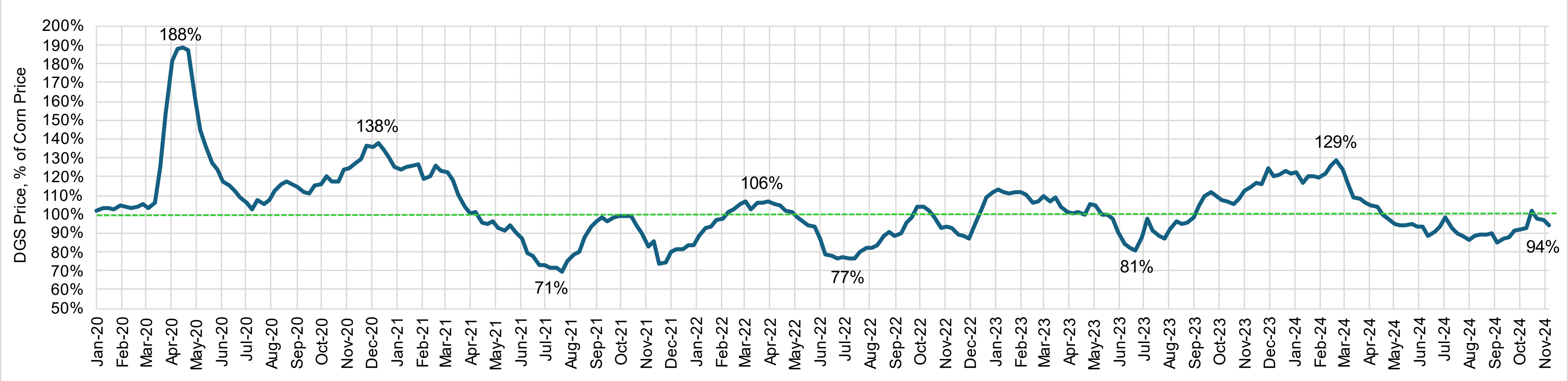
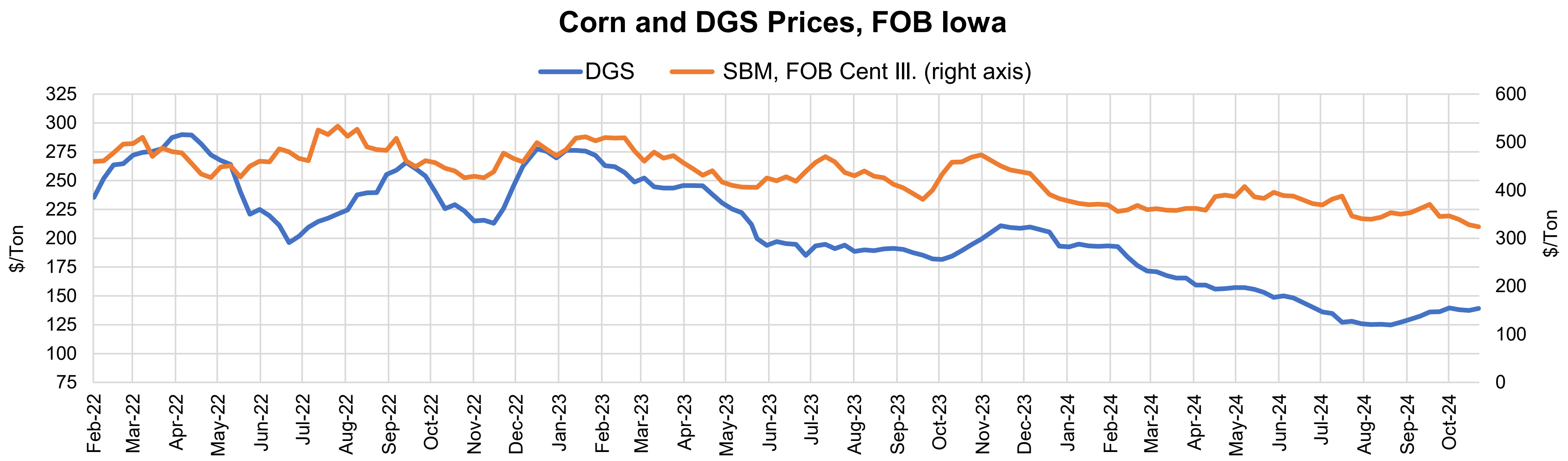
Price Competitiveness Boosts DGS Use

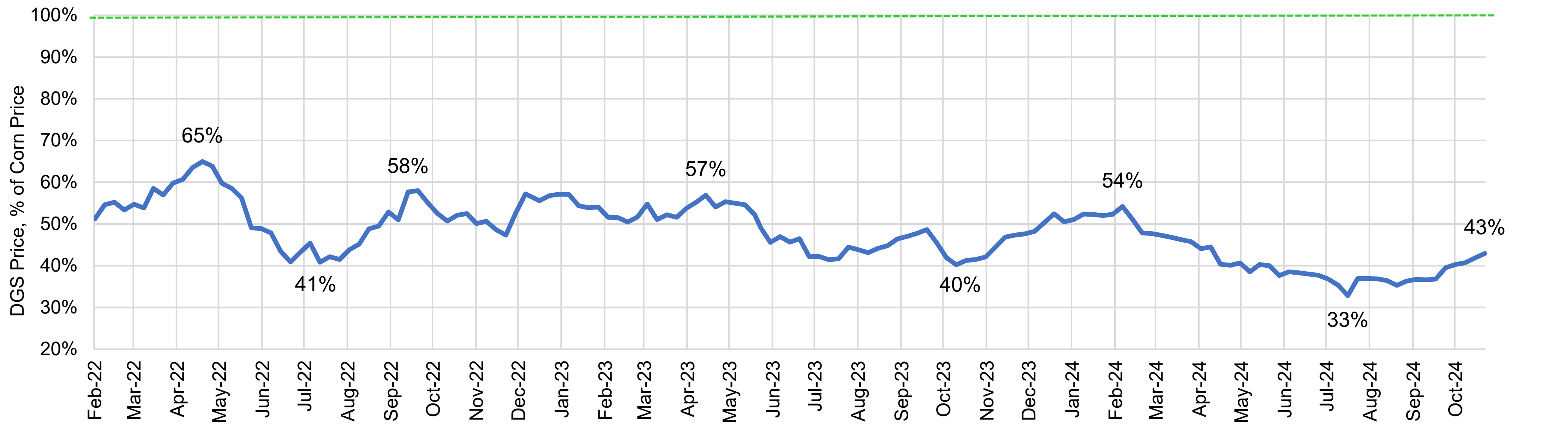




Source: USDA

DGS Prices Relative to Soybean Meal

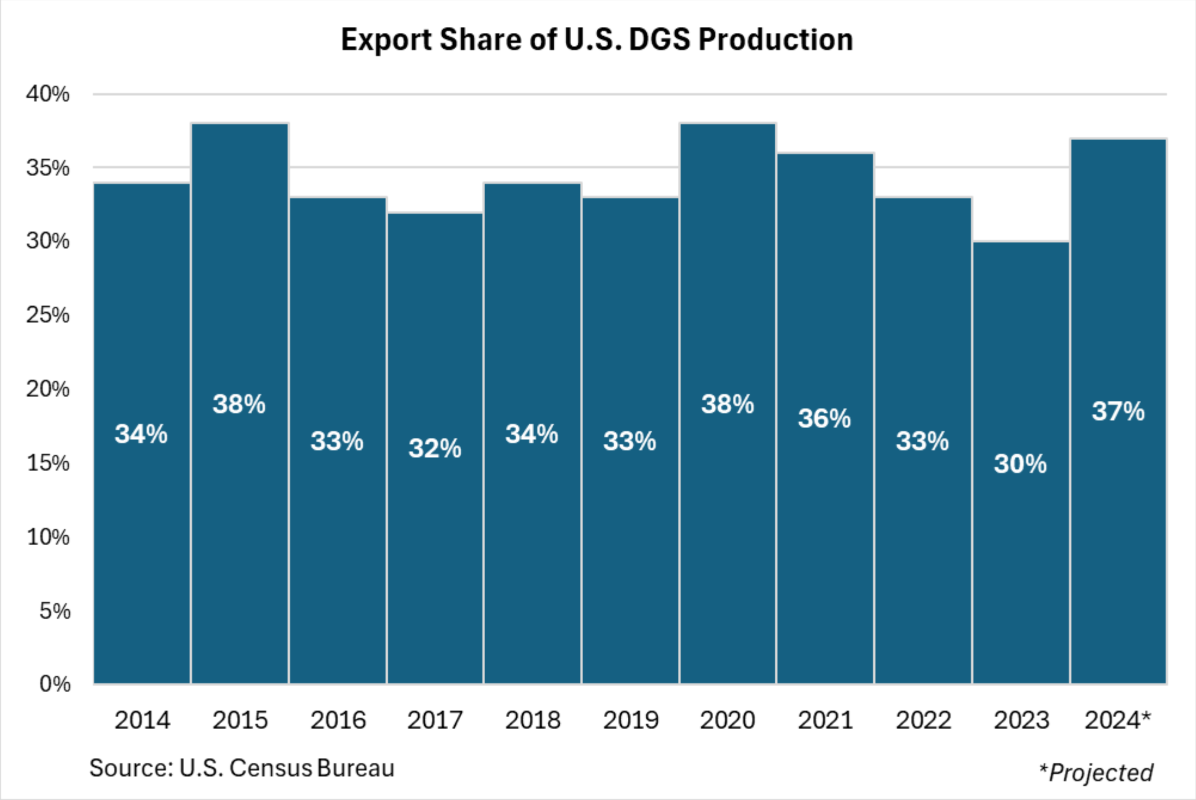


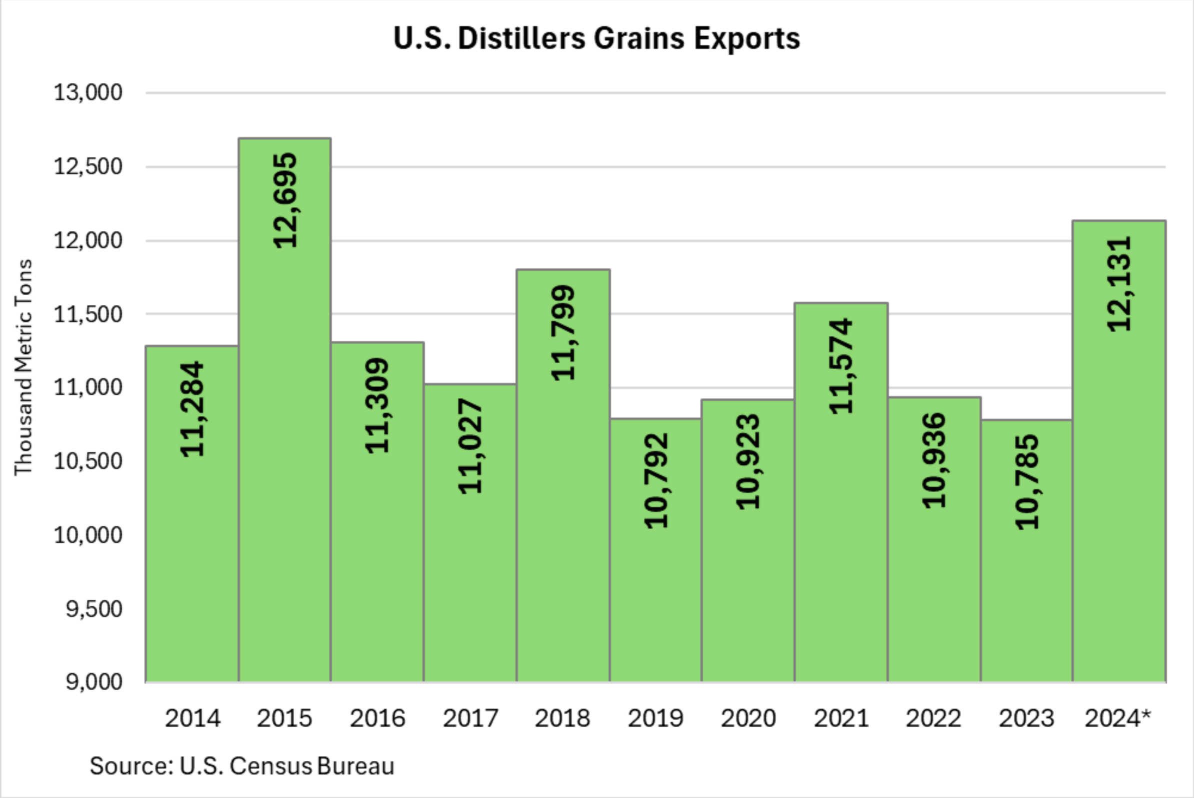


U.S. Distillers Grains Exports

As U.S. DGS production has grown over time, the development of export markets has been essential.

2023: **10.8 million** metric tons to **56** countries
2024: **13%** ahead of last year at this time, or **12.1 mmt** annualized





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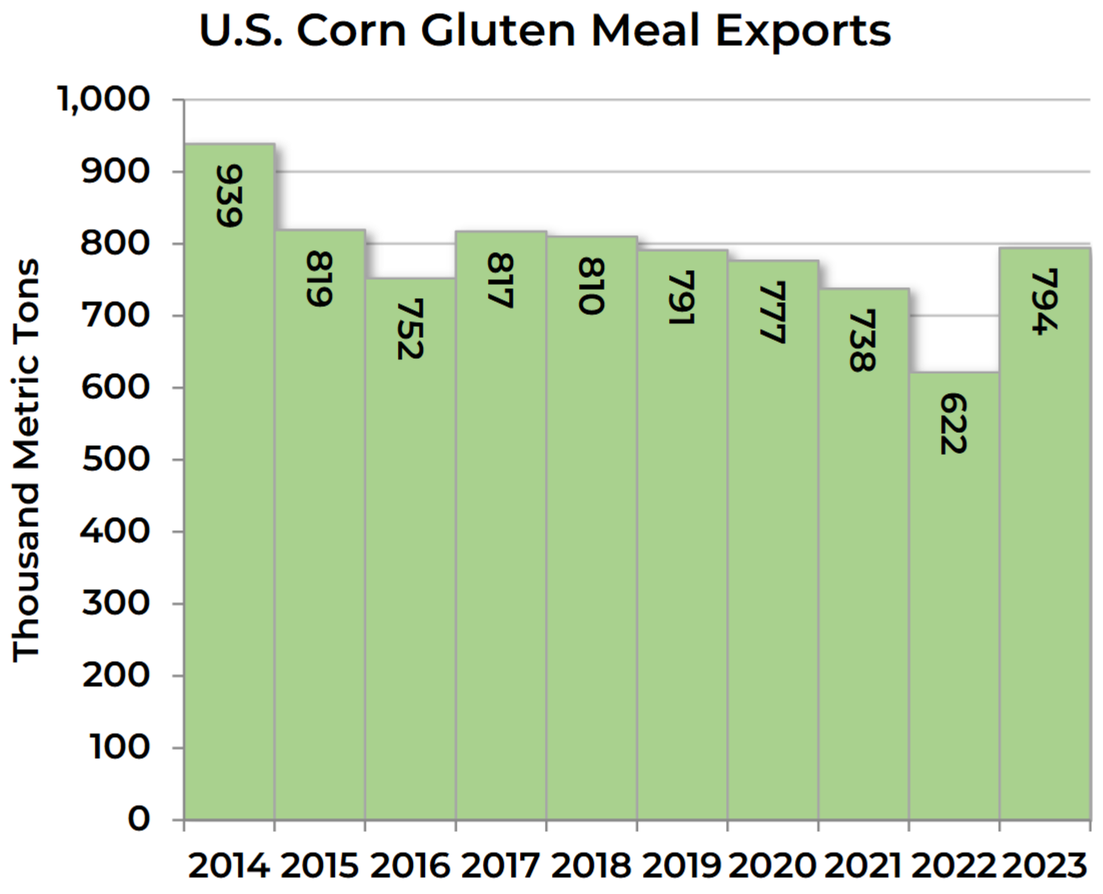
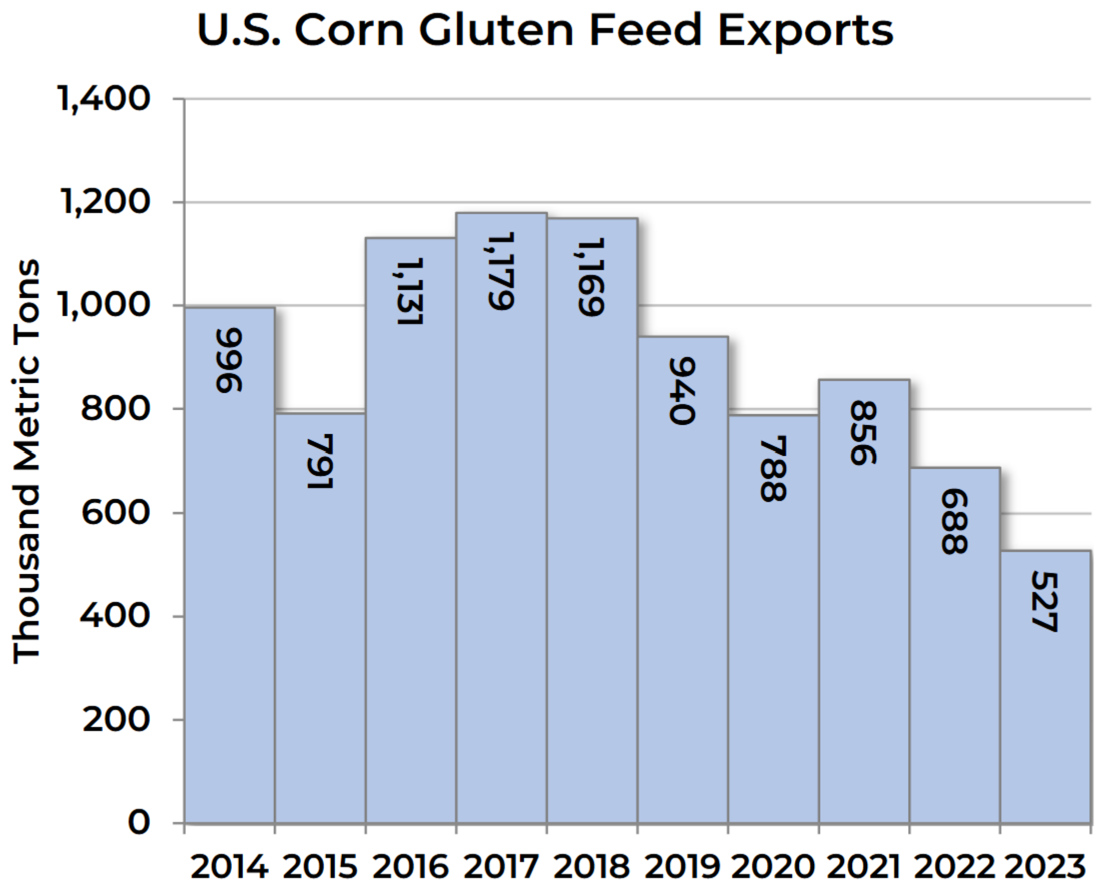
Wet Mill Co-product Markets

CGM exports of **794,000 mt** in 2023 reached the highest level in five years. Chile, Indonesia, and Colombia remained the top destinations.

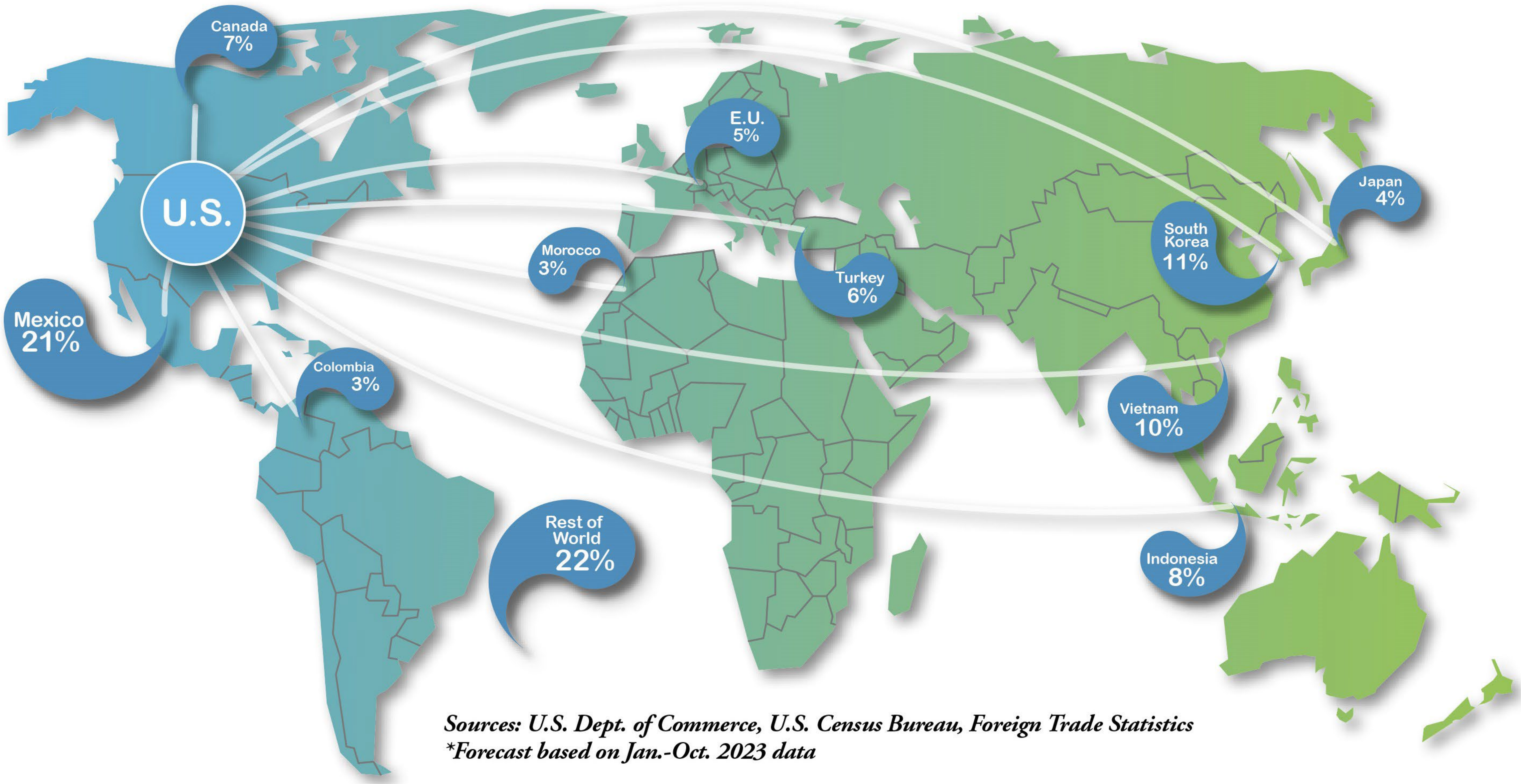
CGF exports fell to **527,000 mt**, mainly due to a drop in shipments to Ireland, the largest destination.





Source: U.S. Census Bureau

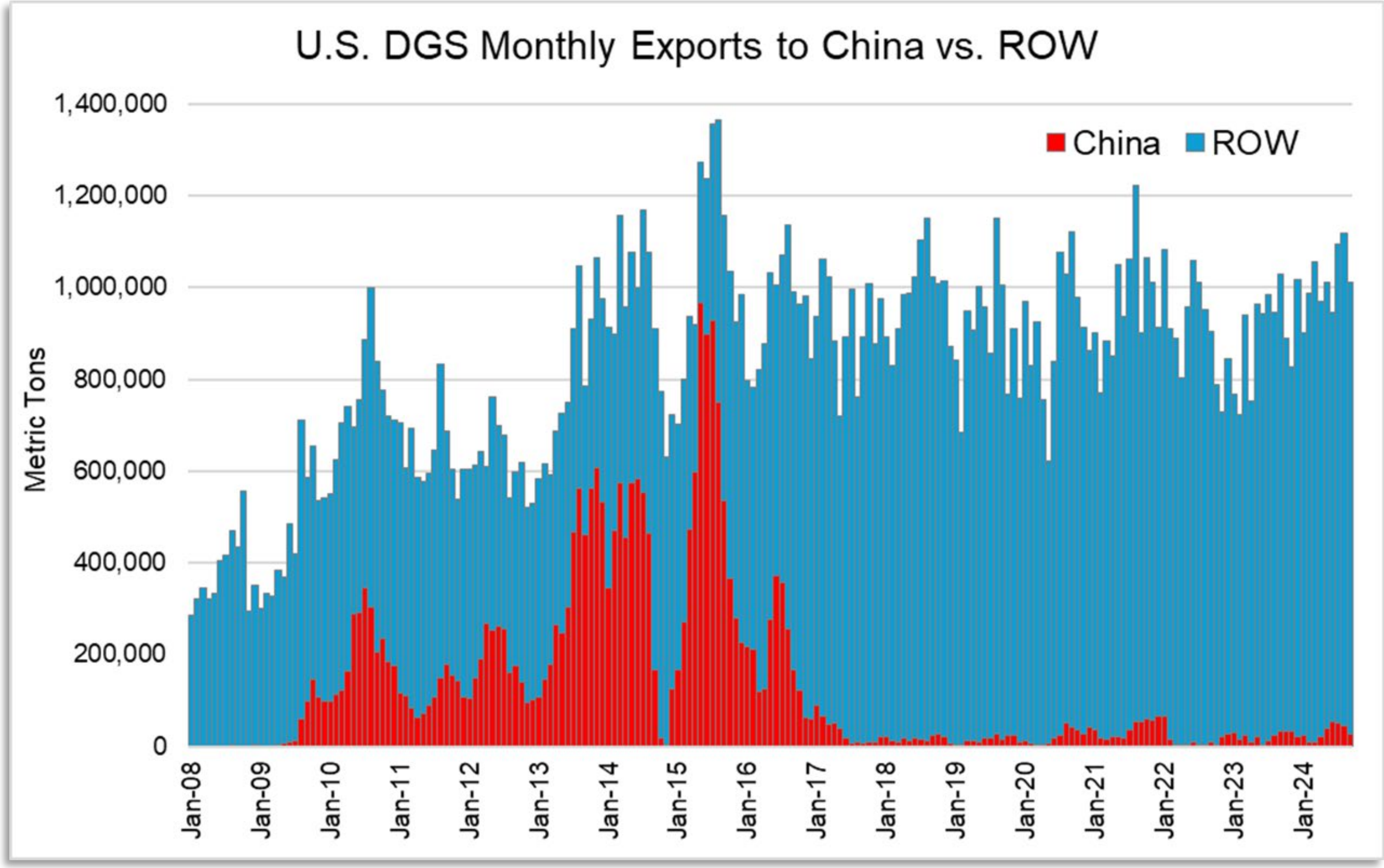
TOP DESTINATIONS FOR U.S. DISTILLERS GRAINS



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**Forecast based on Jan.-Oct. 2023 data*

Continued Uncertainty in China

- U.S. DGS exports to China have been **highly volatile** since 2008
- China initiated anti-dumping case in late 2010; dropped case in 2012
- **Rapid export growth** in 2012-2014
- Exports **plummet** in late 2014 due to effective ban on MIR-162
- Exports **surge** in early 2015 after MIR-162 approval
- China began second anti-dumping case in early 2016
- Preliminary determinations issued in 2016, with **final determinations** issued in 2017**:**
  - **33.8-53.7% AD duty** and **11.2-12.0% CVD**
  - Exports to China subsequently **crash**
- No agreements made to reduce duties during the U.S.-China Phase One Trade Deal in 2020
- **Today, tariffs remain in place** and China's demand for U.S. DGS has not returned to pre-2016 levels



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Volatile U.S. Ethanol Export Market Outlook

Export demand faces challenges due to fluctuating trade policies, tariffs, and phytosanitary requirements in key markets. However, if export barriers are removed, there would be increase in ethanol and DGS supply.

Rank	Export Destination	Jan-June 2024	Jan-June 2023	% Change	Trade Barriers
1	Canada	320,042,263	286,753,997	12%	None
2	United Kingdom	124,658,253	69,896,544	78%	Tariffs: £0.160/liter (Undenatured), £0.085/liter (Denatured). Restrictive water specification. Crop-based biofuels cap starts at 7% in 2027 and decreases to 2% by 2032.
3	India	100,862,133	36,068,082	180%	Import of ethanol for fuel use banned. 5% import tariff on 220720 is equivalent to the Goods and Services Tax levied on domestic fuel ethanol. Importers must have an import license.
4	European Union	90,322,522	86,071,397	5%	220710 tariff of €0.192/liter, 220720 tariff of €0.102/liter. Sustainability requirements (e.g., required minimum 50% or 60% GHG savings depending on when the plant was built).
5	Colombia	63,720,911	22,574,533	182%	$0.0665/kg ($0.052/liter) CVD on imported U.S. ethanol through 2028, with a potential review in 2025/26. Both domestic and imported ethanol must comply with third-party certifications that follow ISO Standard 14064-3.
6	South Korea	41,766,068	65,462,534	-36%	None
7	Philippines	40,087,308	11,848,330	238%	Biofuels Act of 2006 mandates all domestic ethanol must be exhausted before imports are allowed. 1% duty imposed if imported ethanol is used for fuel blending.
	Rest of World	181,298,213	105,673,220	72%	n/a

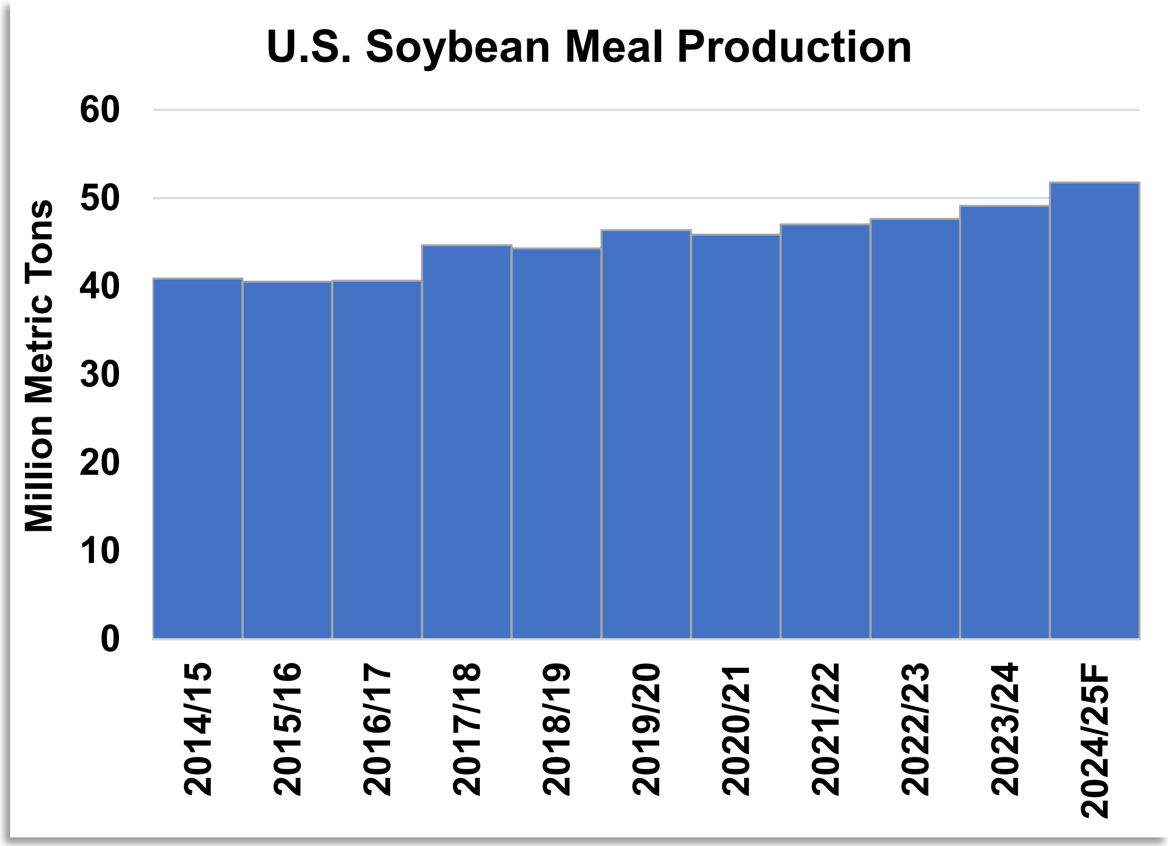
U.S. DGS Export Trade Barriers

These trade barriers increase costs, require additional compliance measures, and can make U.S. DGS less competitive in these markets.

Rank	Export Destination	Jan-Sep 2024	Market Share	Trade Barriers
1	Mexico	1,903,303	21%	Quality Standards and Documentation
				Phytosanitary Regulations
2	South Korea	1,203,511	13%	Phytosanitary Requirements
				GMO Regulations
3	Indonesia	789,959	9%	Import Licensing
				Phytosanitary Certificates
4	Vietnam	700,020	8%	Phytosanitary Standards
				Import Restrictions
5	Turkey	637,815	7%	Import Tariffs (Periodic)
				Import Licensing
6	European Union	506,189	6%	GMO Restrictions
				Phytosanitary and Quality Standards
7	Canada	493,152	5%	None
8	Japan	356,937	4%	Phytosanitary Requirements
				GMO Labeling
9	Colombia	322,759	4%	Quality Standards and Documentation
				Import Licensing
10	China	280,329	3%	Anti-Dumping (33.8-53.7%) and Countervailing Duties (11.2-12.0%)
				Phytosanitary Requirements

Biodiesel Boom Implications

- Increased Oilseed Crushing
- Saturated Protein Meal Market
- Lower Protein Meal Prices
- Shift in Feedstock Demand
- Downward Pressure on DCO Prices
- DGS Face More Competition
- Animal Feed Market Shift
- Reduced Biodiesel Demand for DCO



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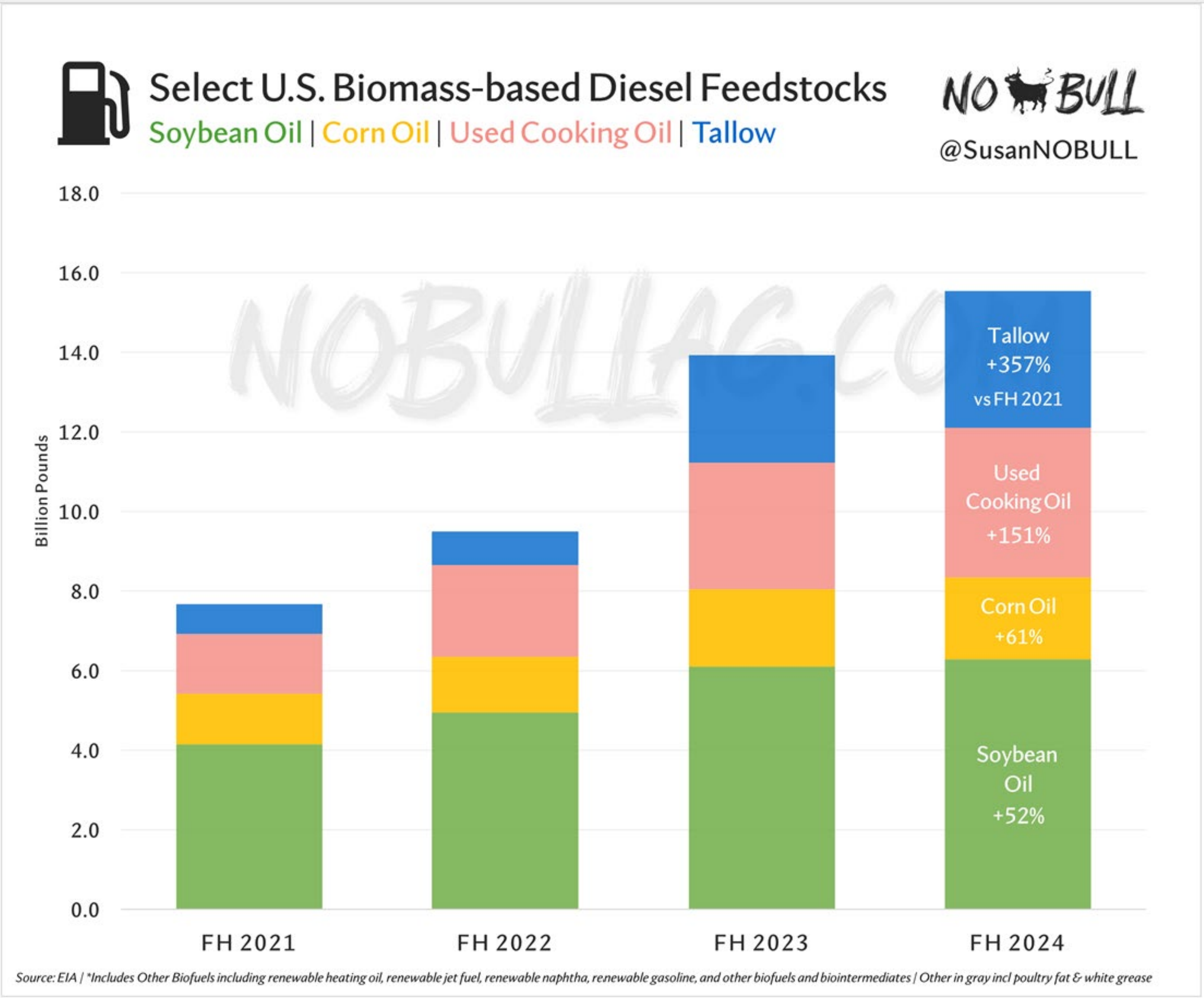
Renewable Diesel Implications



- Pandemic boom industry
- California's LCFS a primary demand driver
- Soybean crush expansion for SBO resulted in a soybean meal surplus and record exports
- Shift away from biodiesel production on policy support
- High SBO prices have curtailed exports, though price adjustments in 2024 may lead to modest export recovery
- Sustained RD growth may become constrained if global SBM demand cannot absorb surplus production

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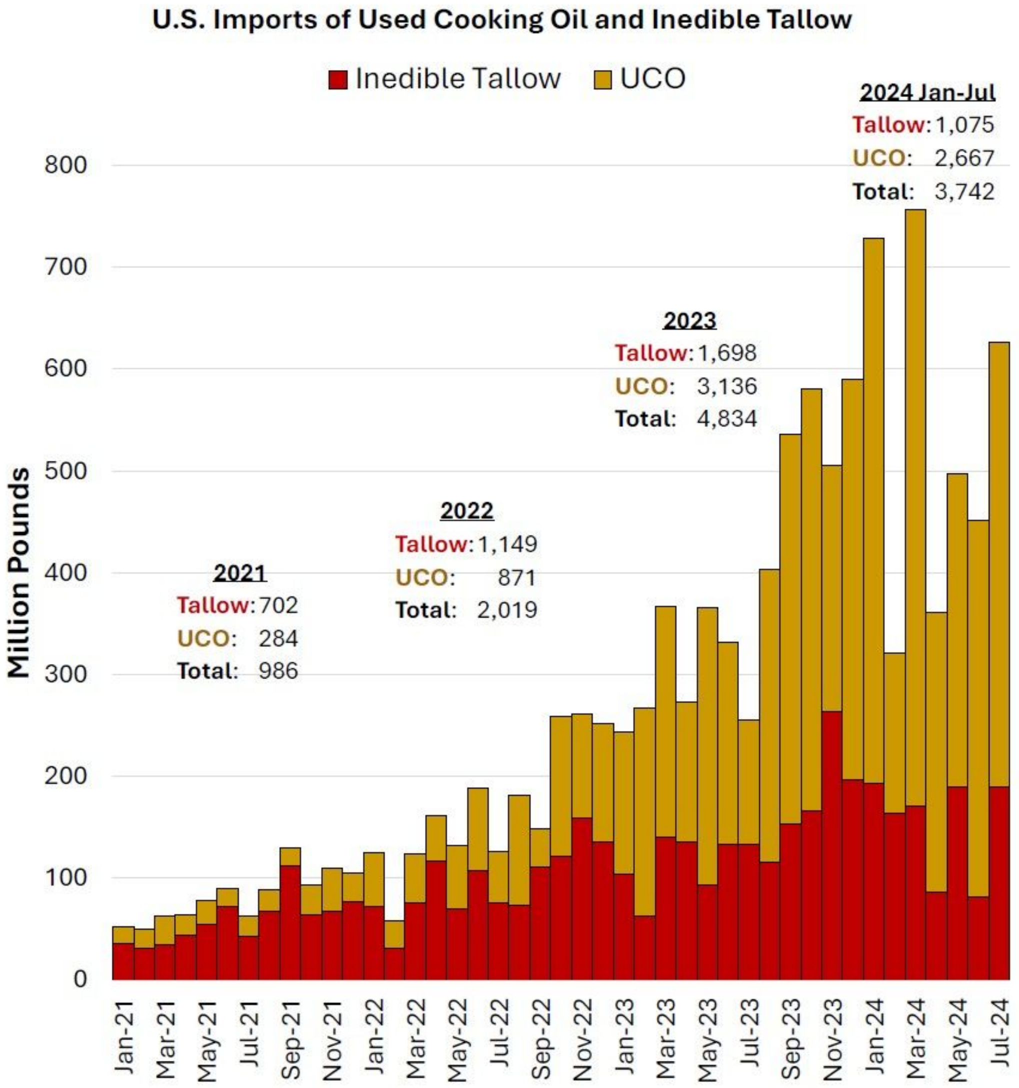
RD (and SAF) Grease Fire: Feedstock Trade Impacts



- Collective imports for animal fats and vegetable oils have grown drastically in alignment with the growth of RD
- U.S. import values of all animal fats and vegetable oils **more than doubled** from 2020 to 2023
- A major driver was **UCO imports**, which **more than tripled** in 2023 on higher imports from **China**
- For the first time, the **U.S. became a net importer of soybean oil** in 2023 due to high domestic demand and elevated prices
- Demand for fats and oils will likely grow due to a shift from a blender's to a producer's tax credit, further driving imports for domestic RD production

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WHEN UCO MEANS YOU SEE, OH!
UCO
PALM OIL
~~VIRGIN PALM OIL~~
VIRGIN PALM OIL

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Thank You