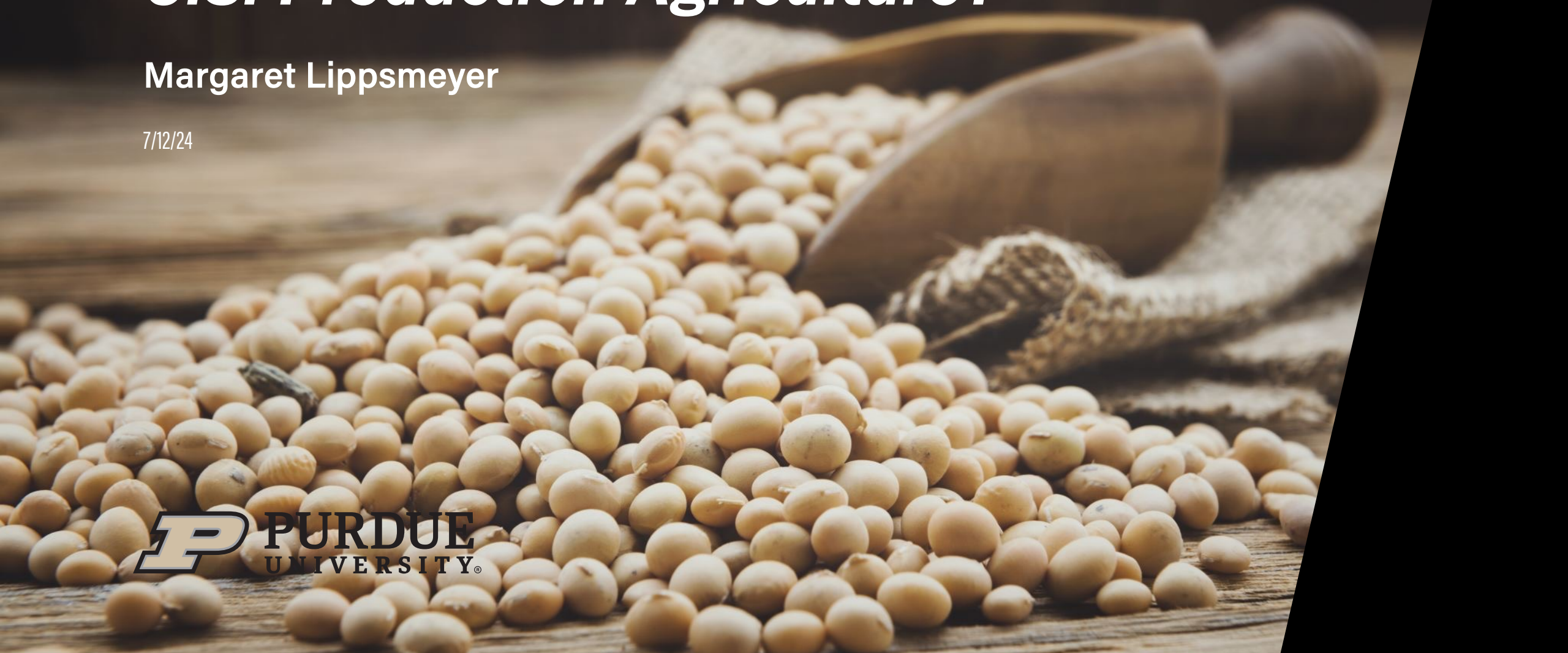


Corn Was King: The Transition to Soy in U.S. Production Agriculture?

Margaret Lippsmeyer

7/12/24



Objectives

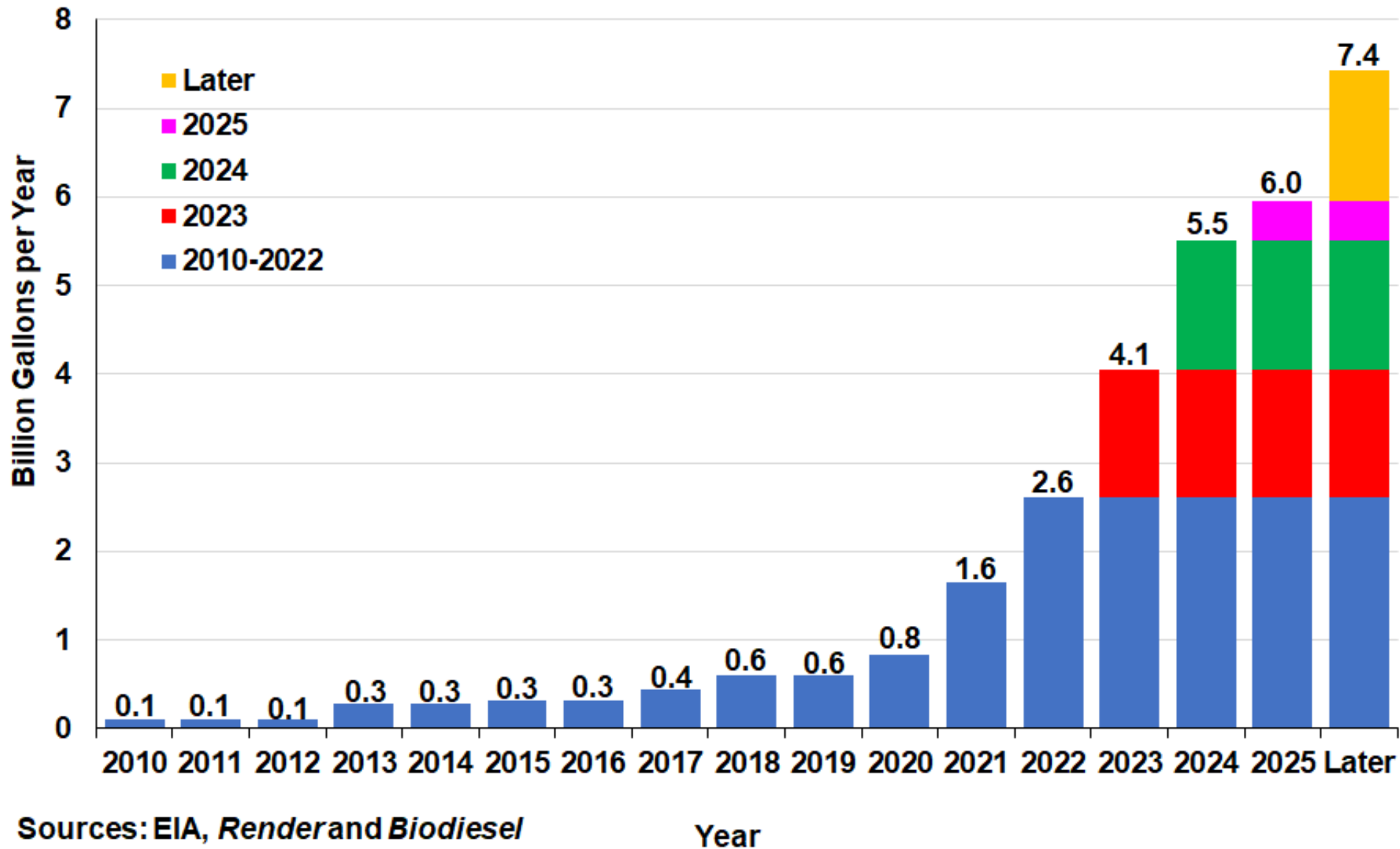
- 1. Discuss how renewable diesel production may influence U.S. producer decision making**
 - Current & Projected Renewable Diesel Capacity**
 - U.S. Export vs. Crush Ratios for Soybeans**

- 2. Identify opportunities for further expansion of U.S. soybean production**
 - U.S. Corn and Soybean Acreage Trends & Profitability**
 - Expanding Soybean Acreage: Potential & Prices**

The Low Carbon Fuel Standard and Renewable Diesel

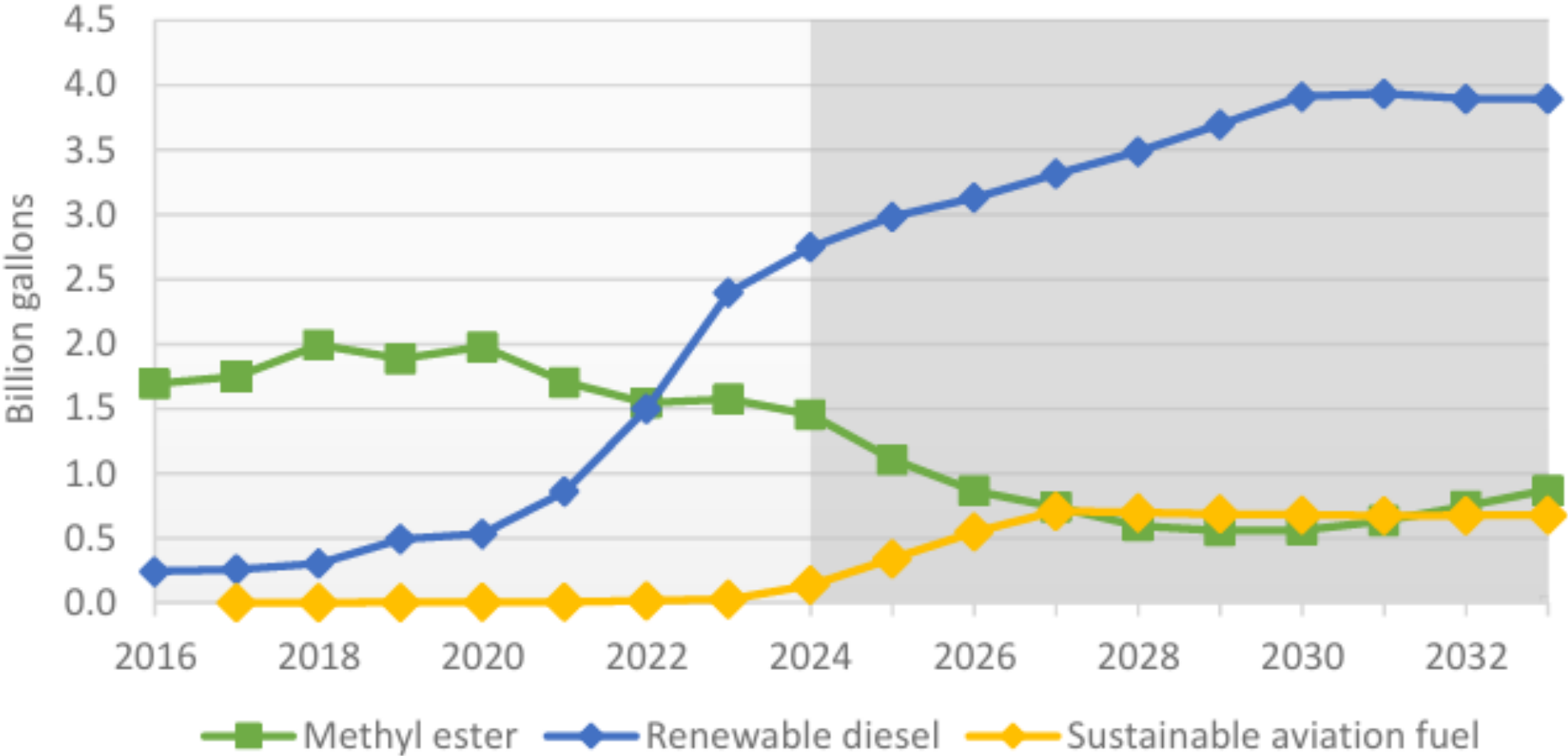
- The Low Carbon Fuel Standard (LCFS) is designed to decrease the carbon intensity of California's transportation fuel pool and provide an increasing range of low-carbon and renewable alternatives.
- Pacific Coast Collaborative is a regional agreement between California, Oregon, Washington, and British Columbia, to strategically align policies.
- Renewable Diesel is...
 - Chemically similar to petroleum diesel and
 - Nearly identical in its performance characteristics
 - It is derived from fat, oil, and grease feedstocks
 - Can be blended into petroleum diesel at higher blend levels compared with biodiesel blends.

Figure 1. Annual U.S. Renewable Diesel Nameplate Production Capacity, Actual for 2010 - 2022 and Projected for 2023 - 2025 and Later



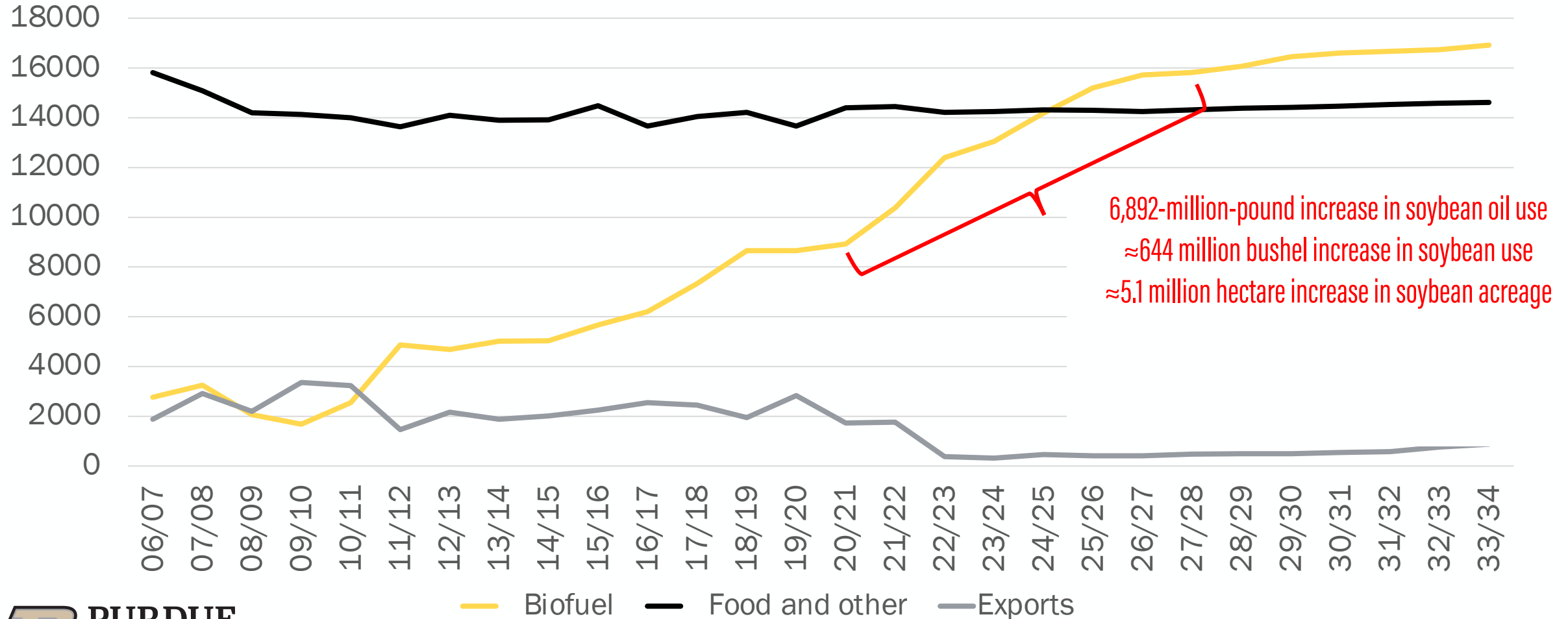
FAPRI - Current & Projected Demand

Renewable diesel production continues to climb



FAPRI-MU Demand for Soybean Oil

Soybean Oil Use by Year
(Million Pounds)



644 Million
Bushel Increase
in Demand

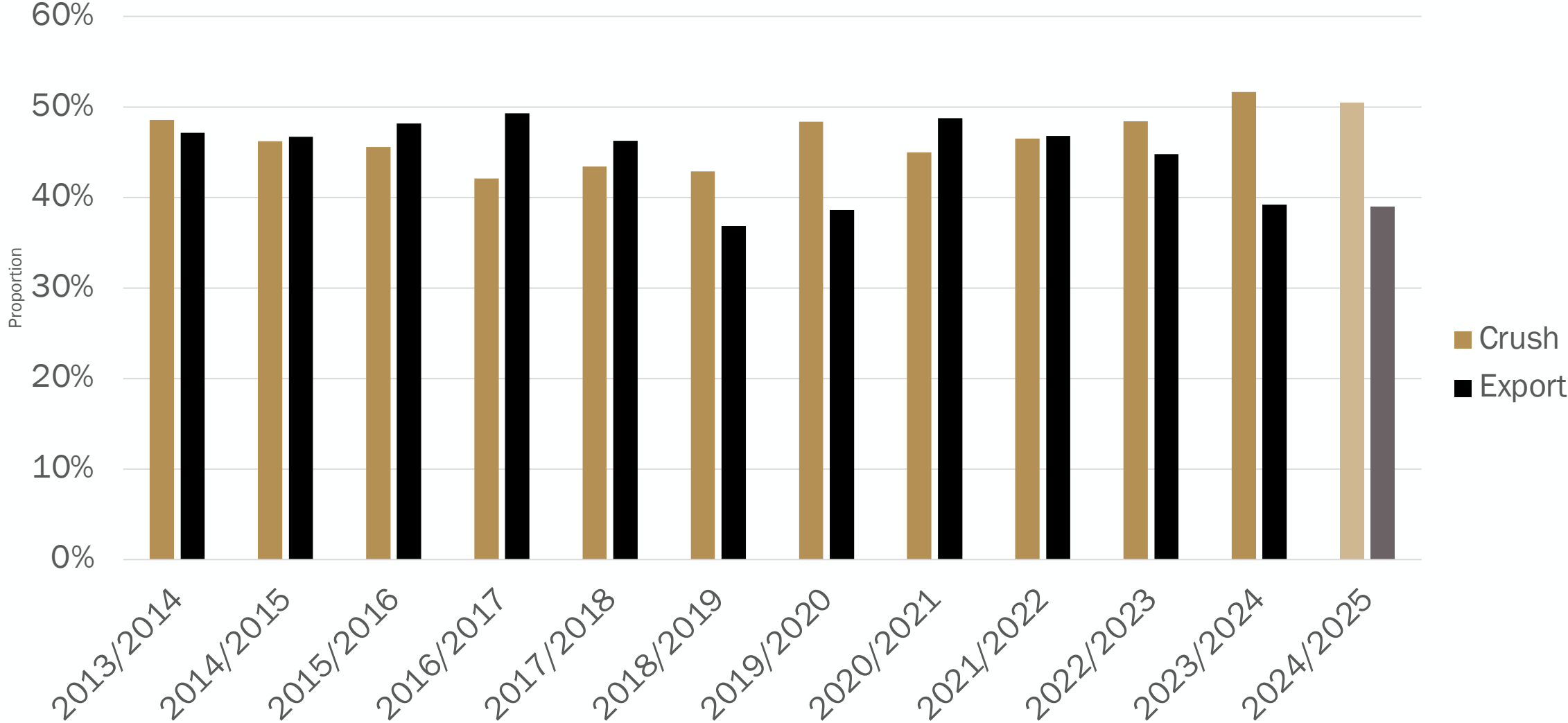
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graph LR; A[644 Million Bushel Increase in Demand] --- B[Change Crush Ratios]; A --- C[Increase Soybean Production]
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Change Crush
Ratios

Increase
Soybean
Production

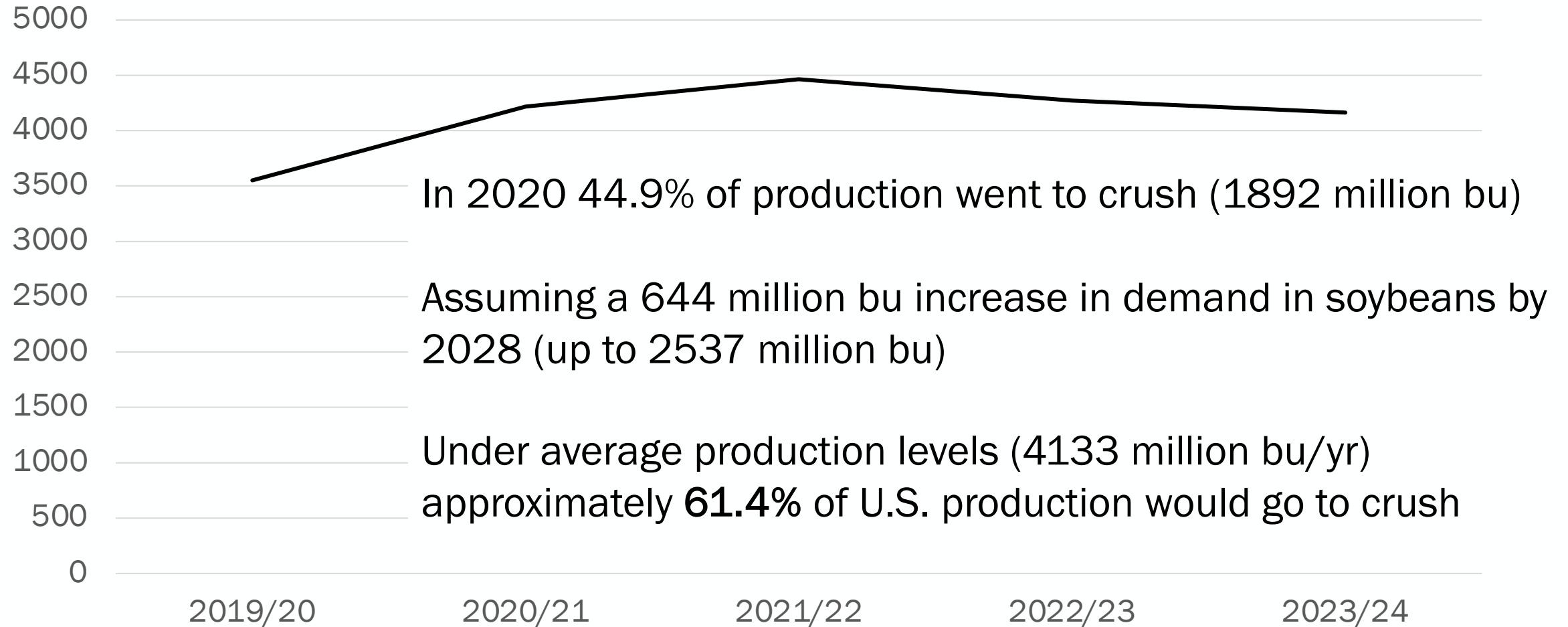
Uses of U.S. Soybean Supply

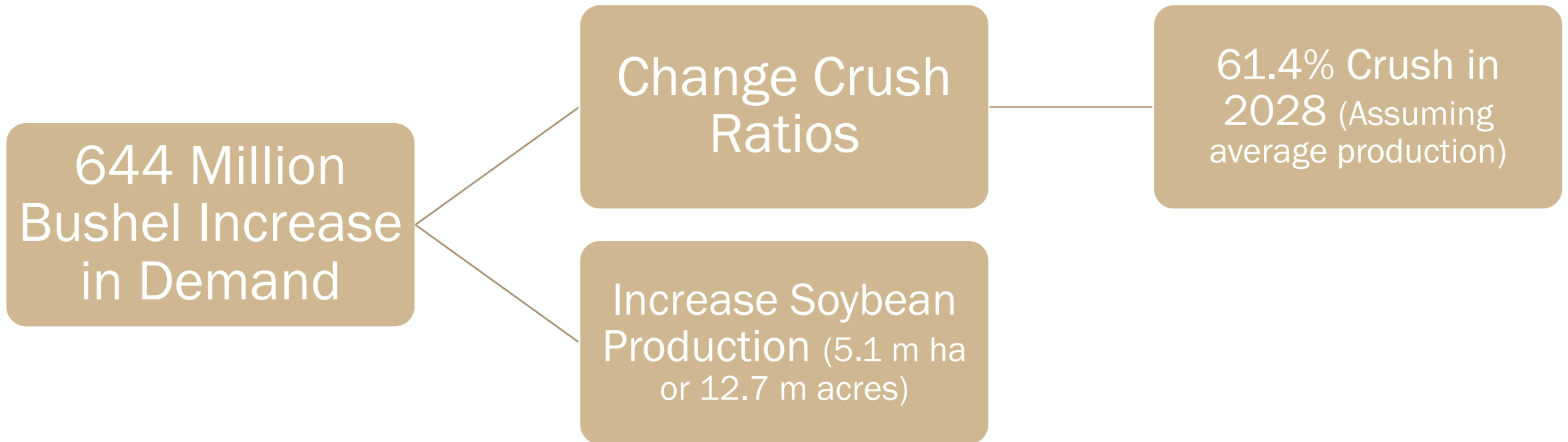
Source: WASDE



U.S. Soybean Production in Millions of Bushels

Source: USDA-ERS Oil Crops Yearbook

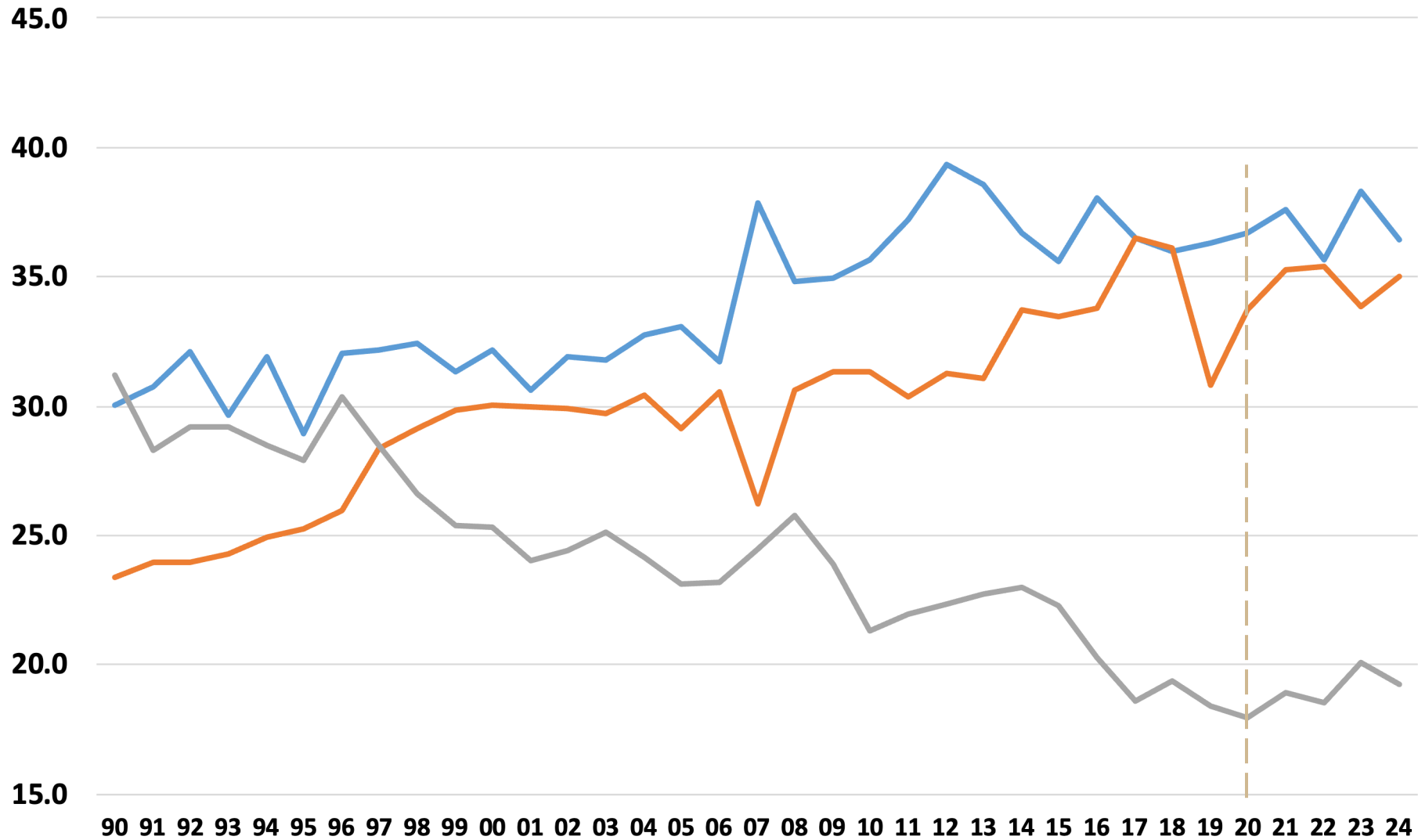




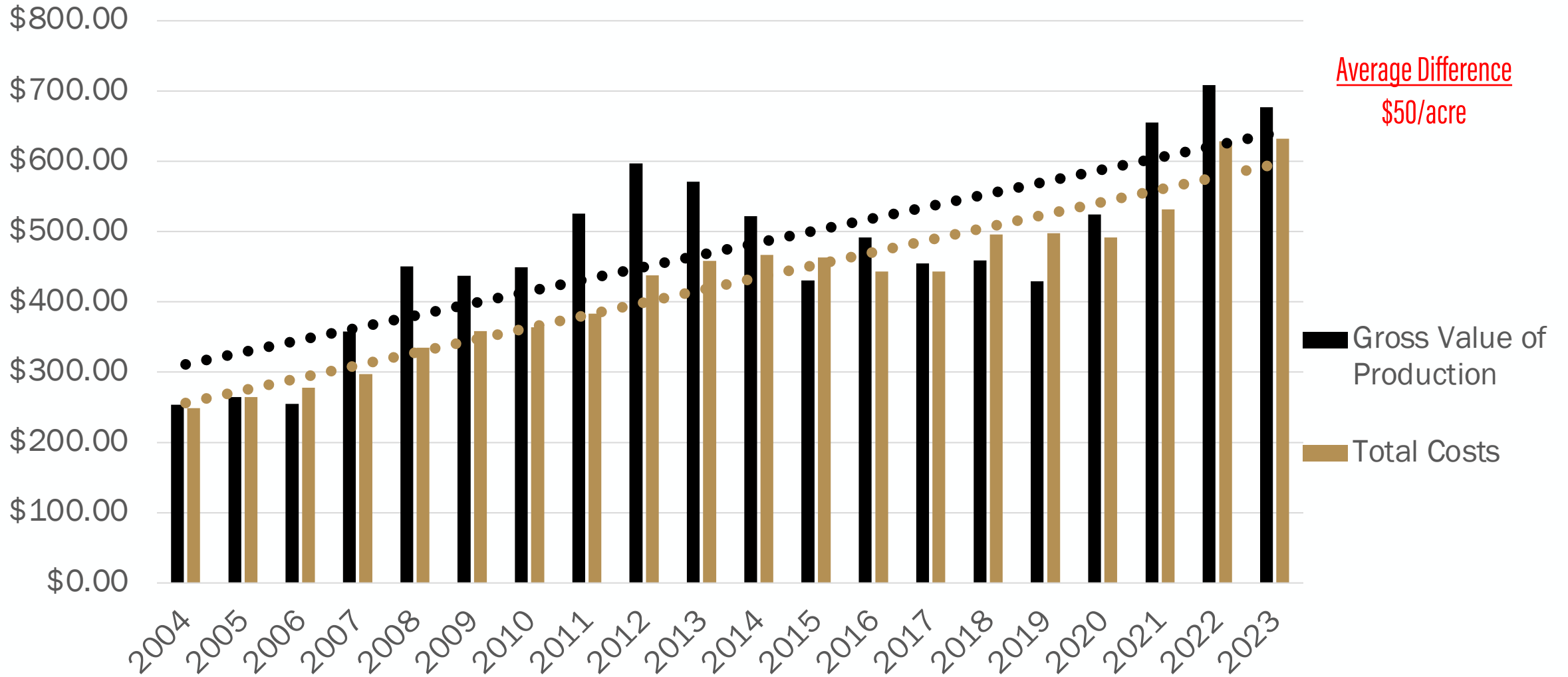
U.S. Corn, Soybean, and Wheat Hectares (millions)

Source: USDA-NASS, Quick Stats

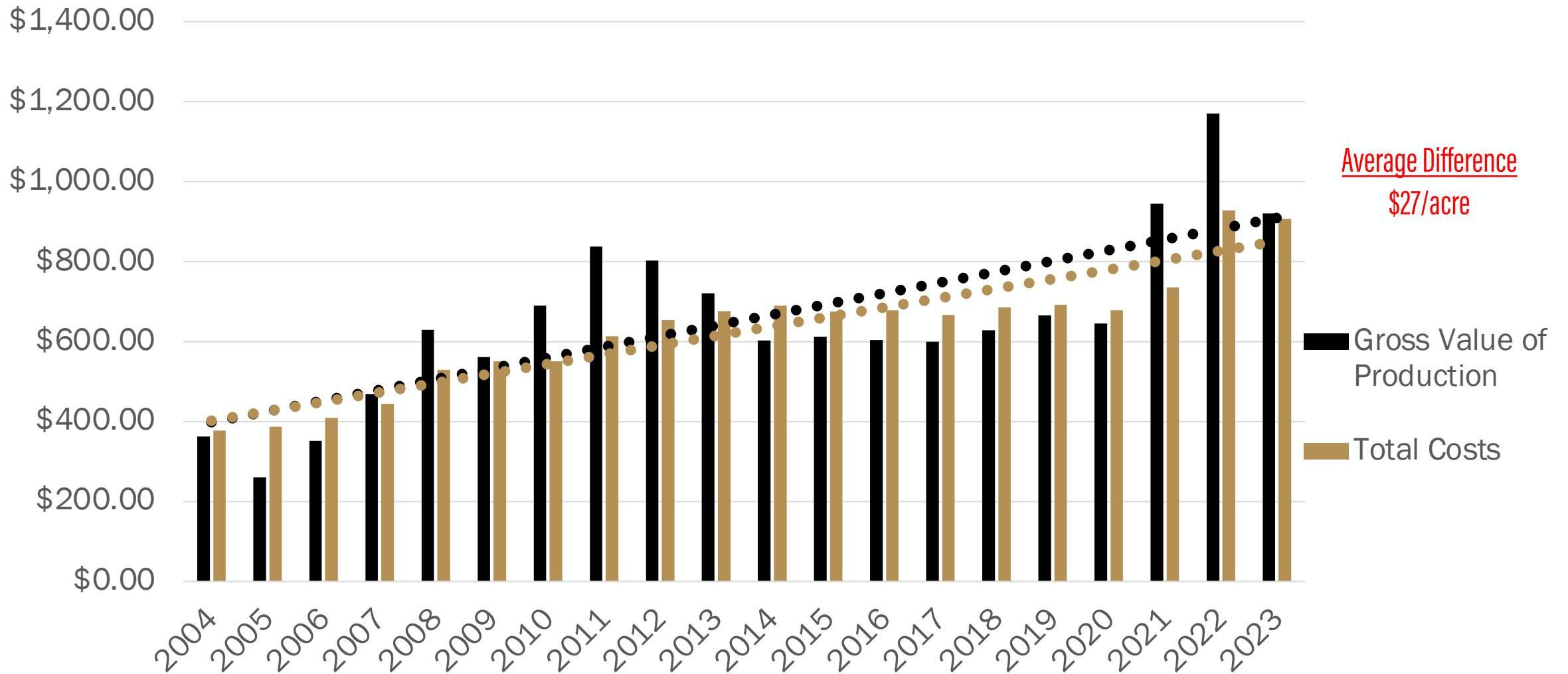
— Corn — Soybeans — Wheat



U.S. Soybean (Gross Value of Production & Total Cost)



U.S. Corn (Gross Value of Production & Total Cost)



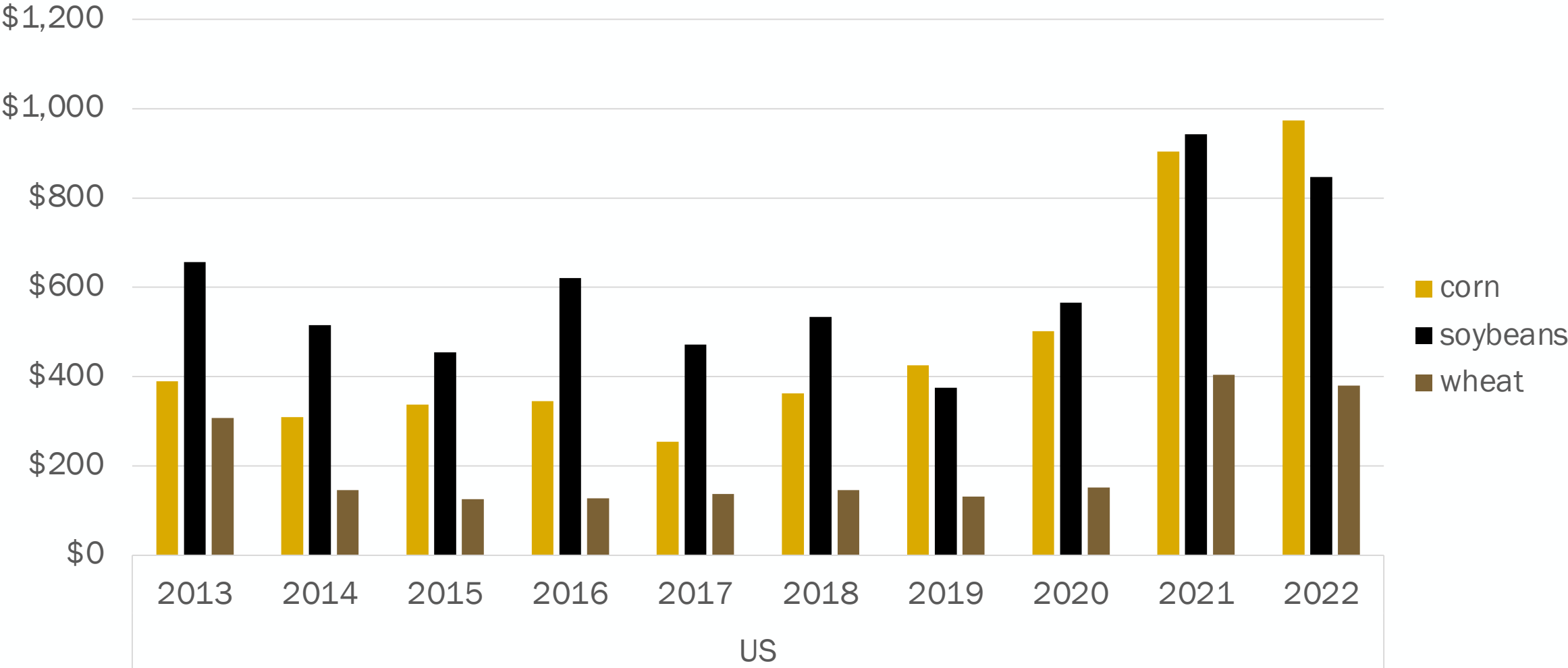
agri benchmark: Return to Land

Average Return to Land Corn: \$480/ha

Soybeans: \$598/ha

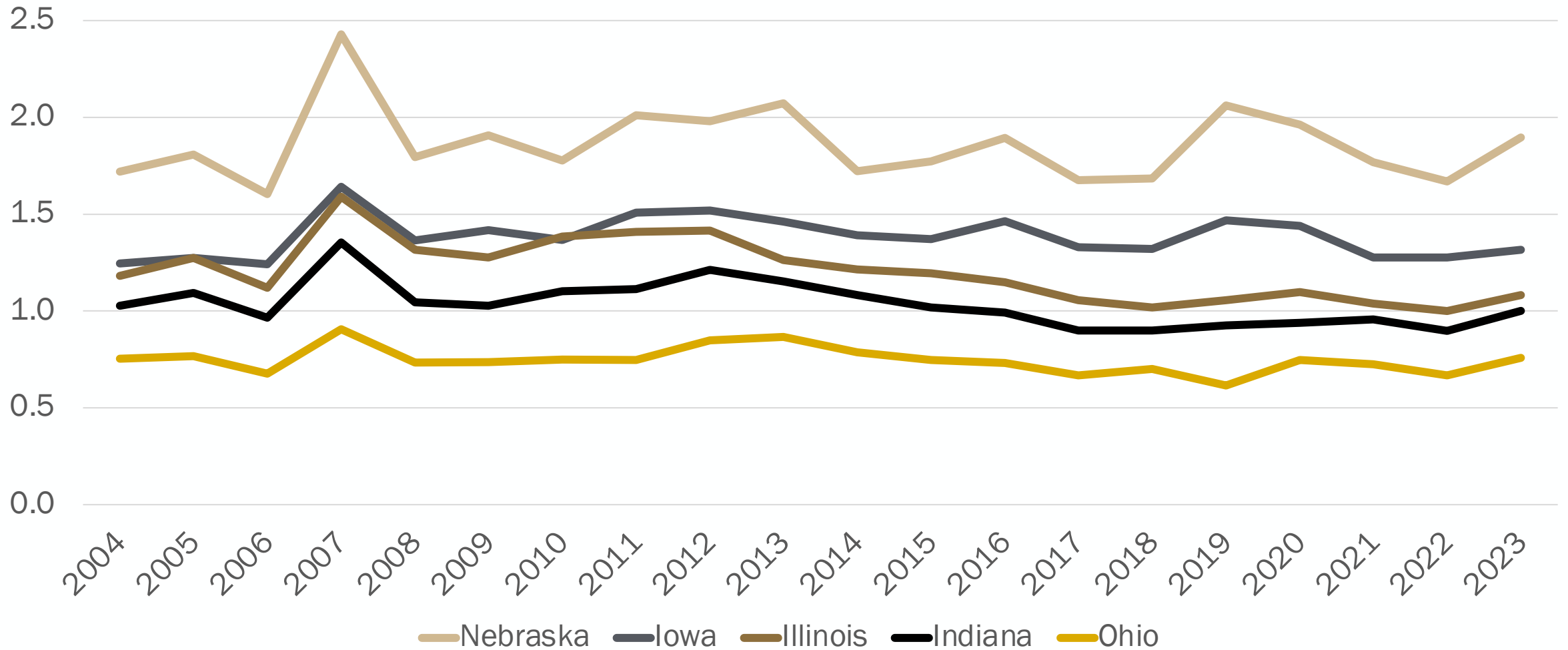
Wheat: \$205/ha

Average Return to Land by Year



Ratio of Corn to Soybean Acreage in the U.S. Corn Belt

Source: USDA-NASS, Quick Stats



Limitations to Soybean Expansion

Disease Pressures

- White Mold: 3–5-year lifespan
- Soybean Cyst Nematode: permanent, 30%+ yield reduction

Weed Resistance

- Limited herbicide variability under monocropping

Reduced Soil Organic Matter & Soil Health

- Soybeans produce
 - ≈ 25% of organic matter produced by corn
 - ≈ 60% of organic matter produced by wheat

Limitations to Soybean Expansion

Yields Decreases for Soybean Heavy Rotations

- Soybeans yield 8% to **10%** greater yield when grown in rotation with corn than continuous soybean (Porter, 1997; Pederson and Lauer, 2004; Wilhelm and Wortmann, 2004)
- Houx et al. (2014) reported 12% and 9.2% higher yields for Corn-Soy rotations than continuous soybean under conventional tillage and no-tillage respectively
- Agomoh et al. (2021) reports a **6%** higher yield for Corn-Soy rotations than Corn-Soy-Soy rotations

Expansion Opportunities

- Continuous Corn
- Traditional Corn - Soy
- Corn - Soy - Soy
- Continuous Soy

At what point will we see a transition to soybean intensive rotations?



Using agri benchmark Farm Data

Using 2015-2022 farm data, how much of an increase in soybean price is needed before we see alternate rotations with higher returns to land than traditional Corn-Soy rotations?

- Implementing a 6% reduction in soybean yields in year 2 of a Corn-Soy-Soy rotation (Agomoh et al., 2021)
- Implementing a 10% reduction in soybean yields for continuous soy rotation

Return to Land: agri benchmark (US700IA)

Rotation	2015	2016	2017	2018	2019	2020	2021	2022	Avg RTL
Continuous Corn	544	307	468	466	579	580	1181	1492	702
Corn-Soy	542	485	528	416	489	508	1088	1243	662
Corn-Soy-Soy	515	515	521	377	436	459	1019	1118	620
Continuous Soy	411	519	454	255	284	310	804	783	477

Average Price (2015-2022): \$375.61/t

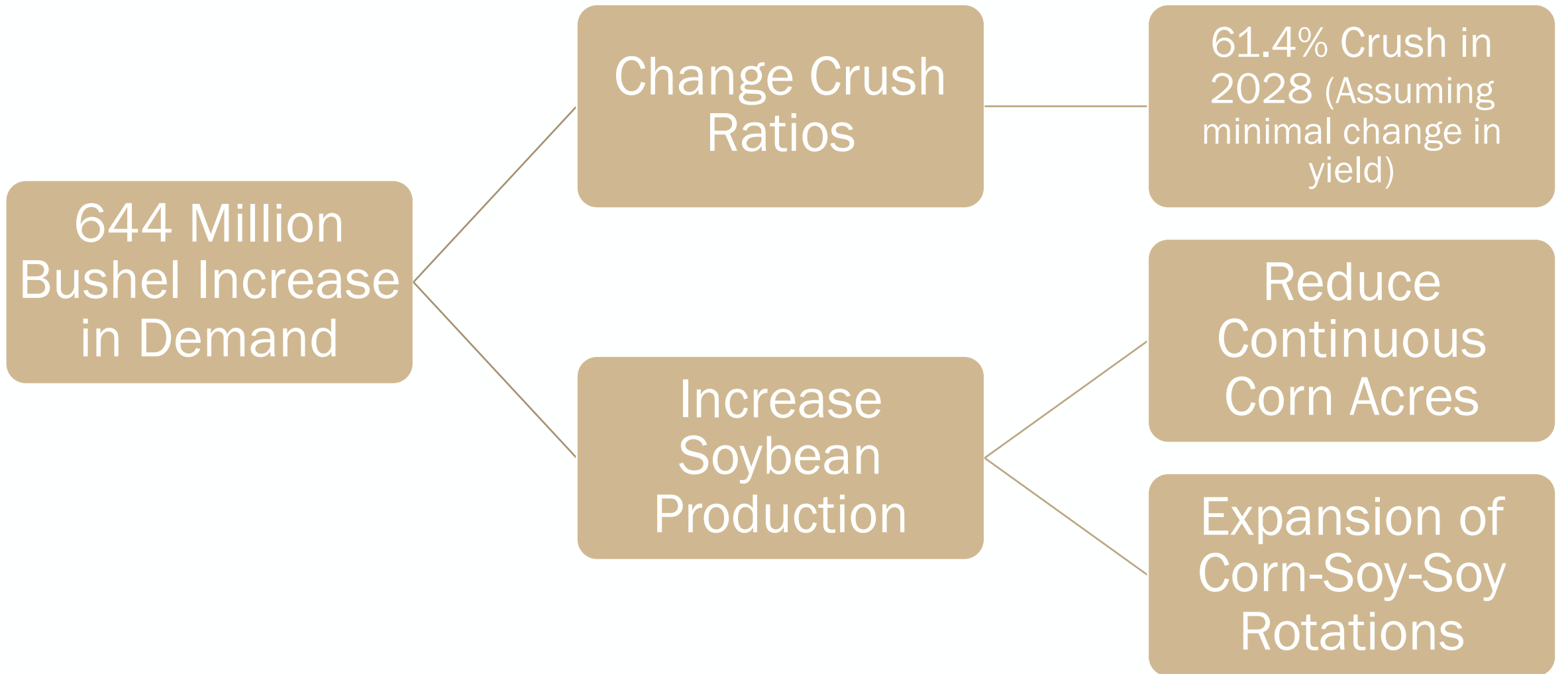
- If there were a 6% increase in soybean price, (avg of \$398.14/t) RTL for the Iowa farm would be higher for Corn-Soy rotations than continuous corn
- If there were a 20% increase in soybean price, (avg of \$450.73/t) RTL for the Iowa farm would be higher for Corn-Soy-Soy rotations

Return to Land: agri benchmark (US1215INC)

Rotation	2015	2016	2017	2018	2019	2020	2021	2022	Avg RTL
Continuous Corn	-36	496	277	434	388	664	1493	1034	594
Corn-Soy	145	628	428	444	369	727	1344	983	633
Corn-Soy-Soy	183	642	451	421	339	715	1252	926	616
Continuous Soy	214	611	440	321	232	626	986.	733	520

Average Price (2015-2022): \$391.77/t

- If there were an 8% increase in soybean price, (avg of \$423.11/t) RTL for the Indiana farm would be higher for Corn-Soy-Soy rotations than Corn-Soy rotations, despite yield penalties
- If there were a 25% increase in soybean price, (avg of \$450.73/t) RTL for the Indiana farm would be higher for Continuous Soy, despite yield penalties



Conclusions

Renewable Diesel and the Low Carbon Fuel Standard

- Significant increase in U.S. renewable diesel production since 2020
- Increased demand for soybean oil (FAPRI)
- 644 million bushel increase in soybean production (2020-2028) to satisfy renewable diesel demand

Meeting Increased Soybean Demand

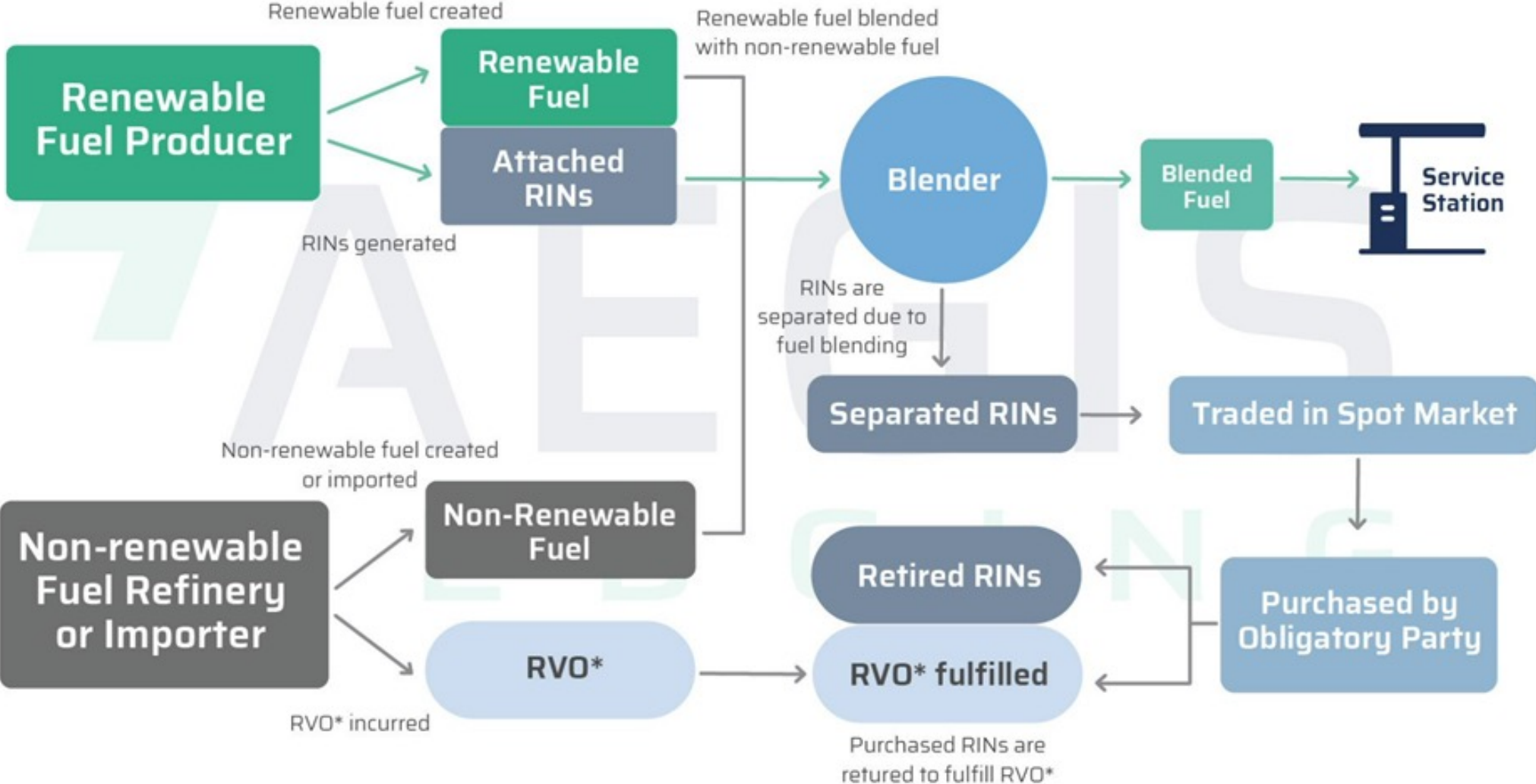
- Increase Crush Proportion
 - 2020: 44.9% Crush
 - 2024: 50.4% Crush (projected)
 - 2028: 61.4% Crush (to meet demand)
- Increase Soybean Acreage (5.1 million ha to meet demand)
 - Less Continuous Corn
 - Transition Corn-Soy to Corn-Soy-Soy rotations

Questions

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RIN lifecycle: Gereneration, separation & retirement



* RVO= Renewable Volume Obligation