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Feedstock Availability for US Renewable Diesel



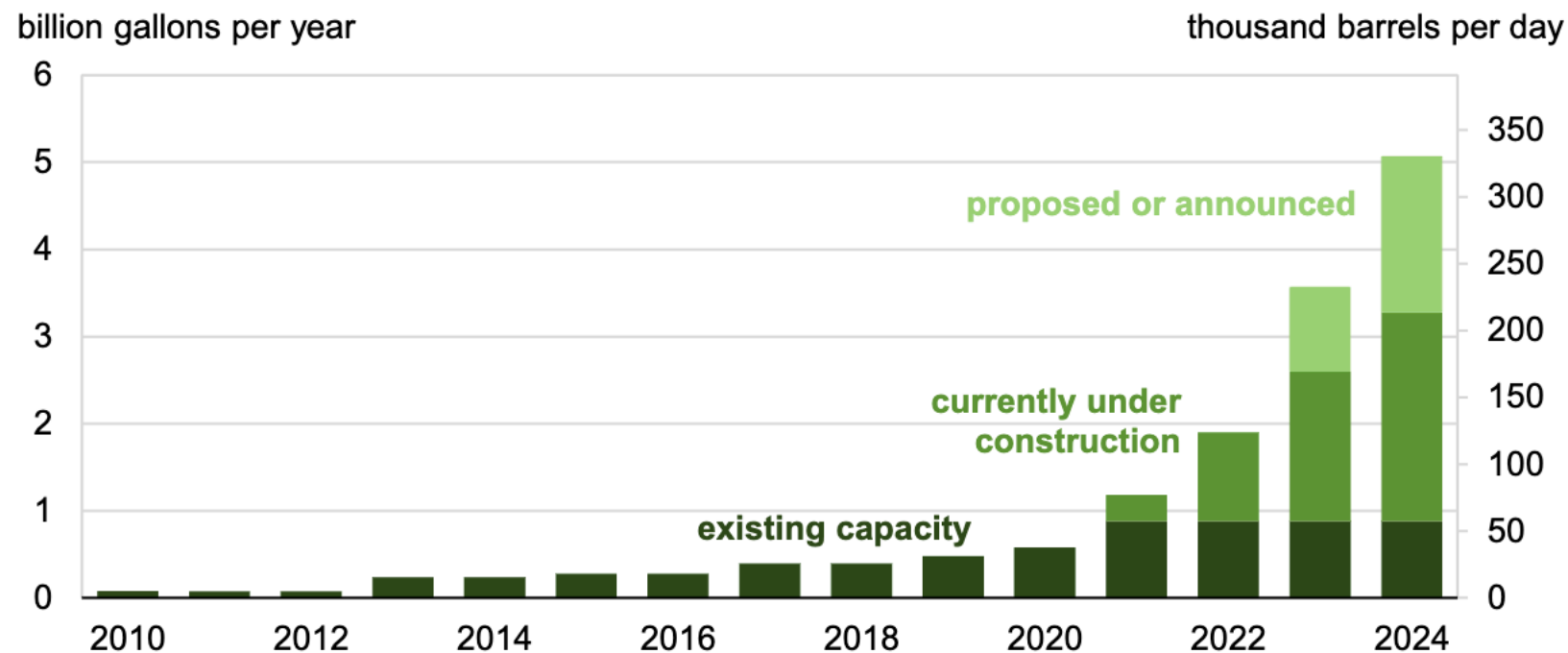
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The Big Picture is Cloudy

- The Energy Information Administration (EIA) estimates that by 2024 renewable diesel (RD) capacity in the US could **grow by 500%** from 2021.¹
- BUT, is there enough feedstock available to meet this increase?
- Many of the feedstocks that renewable diesel relies on are byproducts from other industries, and not easy to scale up
- Adding additional feedstock to supply the industry could be costly and impact the profitability of proposed RD projects

U.S. RD Capacity is Booming

Existing and expected U.S. renewable diesel production capacity (2010–2024)



Source: Graph by the U.S. Energy Information Administration (EIA), based on data from company announcements in trade press



Fewer than 1 billion gallons of RD produced in 2021 in the U.S.

5 billion gallons of expected capacity by end of 2024

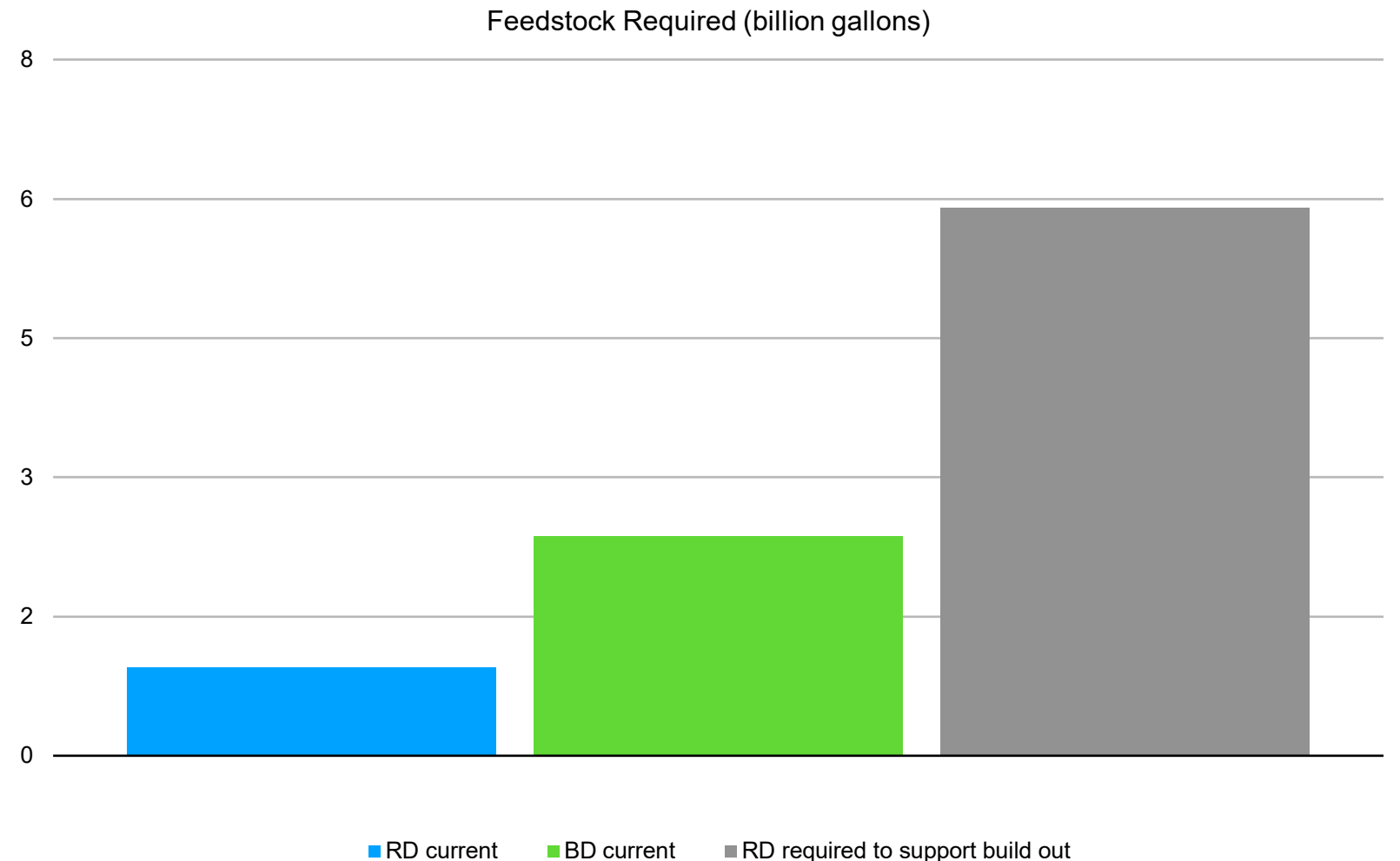


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Source: <https://www.eia.gov/todayinenergy/detail.php?id=48916#>

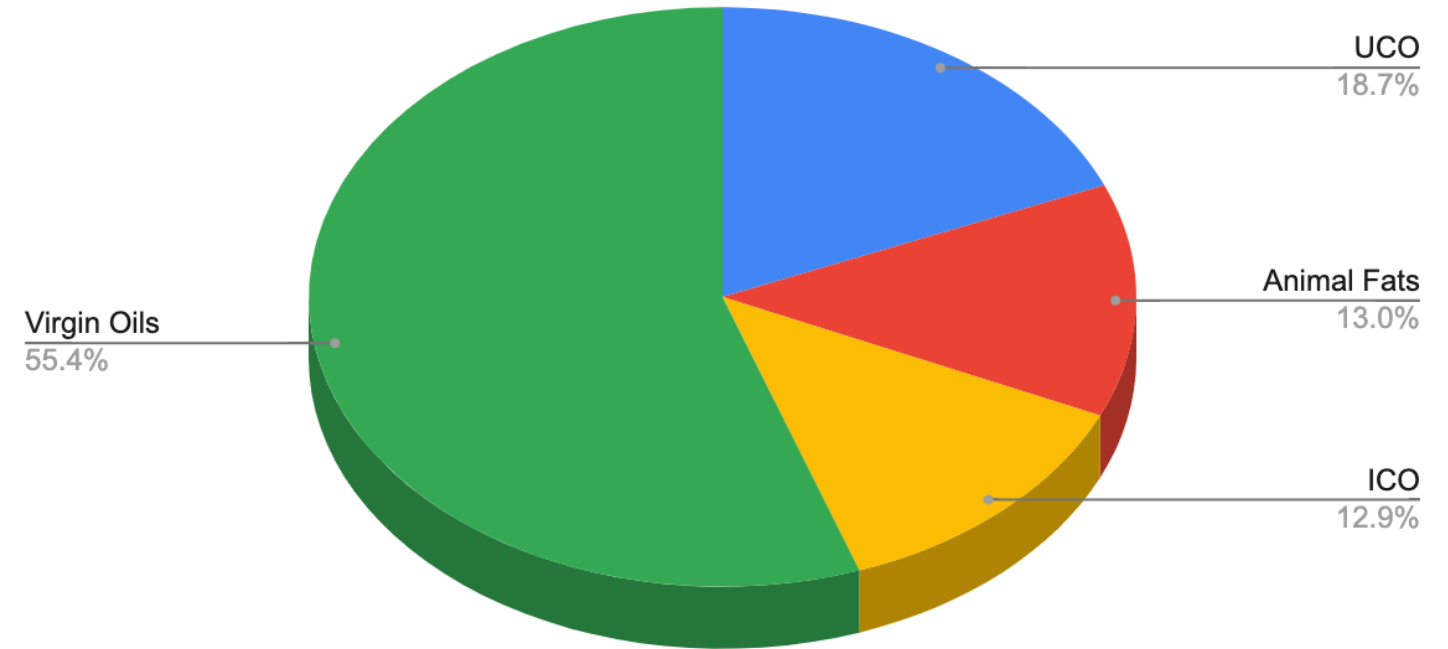
More Feedstock Required to Support RD Growth

- Every gallon of renewable diesel requires 1.14 gallons of renewable oil¹
- To meet the projected expansion of 4BGY of RD, ~4.56BGY of new feedstock must be sourced
- Even assuming that if all of the oil used for biodiesel production migrates to RD production, there would still be a shortfall of ~2.5B gallons of feedstock



The Four Major Categories of Feedstock in the US

In the United States there are four major feedstock types used to make biodiesel and renewable diesel: **used cooking oil**, **animal fats** (tallow, choice white grease, etc.), **inedible corn oil**, and **virgin crop oils** (soy, canola).



Feedstock for biomass-based diesel by category (2021)

Moderate Growth for Used Cooking Oil

Volume: 465.1M gallons (2021)

Potential for growth: More UCO exists than is collected, so some potential growth in this category exists

Imports of UCO could increase further to help alleviate the shortfall

Challenges: Organic growth of the waste grease industry is not anywhere close to the demand for additional feedstock

Diminishing returns to collecting UCO as density of foodservice businesses drops in lower population areas; imports require extra handling and shipping, adding to feedstock cost

Stagnant Growth of Animal Fats*

Volume: 323.5 gallons (2021)

Potential for growth: Animal fat production is directly tied to the rendering industry, so growth in this category only occurs with meat production.

US is a net exporter of Animal Fats, so there is potential for greater domestic use.

Challenges: Though the mix of different meats consumed has changed, per capita U.S. meat consumption has increased <1% annually since 1999.

Buying animal fats away from other industries (e.g. pet food, animal feed) is possible, but these are higher margin industries, so a greater premium would need to be paid.

Declining Supply of Inedible Corn Oil

Volume: 321.6M gallons (2021)

Potential for growth: ICO production is directly tied to ethanol production, so growth in this category only occurs with ethanol growth

Challenges: The USDA projects a long term decline in ethanol production beginning this decade.

- Ethanol is at the mandated “blendwall”, so blending more into the gasoline pool is not an option
- Long term demand for gasoline in the US is dropping, decreasing blending opportunities

Virgin Crop Oils Hold the Most Growth Potential*

Volume: ~1.377B gallons (2021)

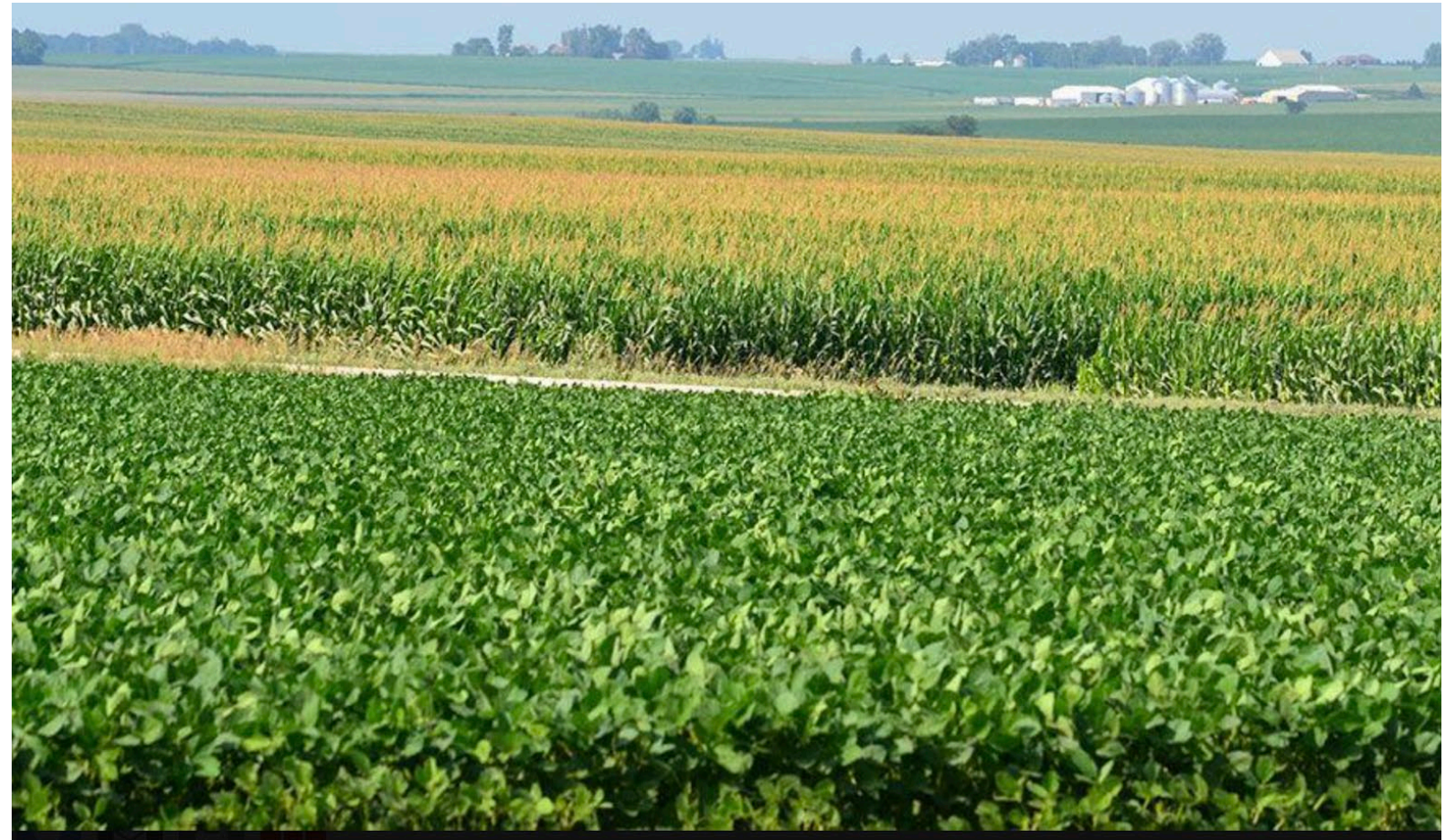
Potential for growth: Has the most potential for growth as new acreage can be planted to meet demand

Challenges: Economic incentives (i.e. higher prices) likely required to encourage farmers to plant more crops

Highest carbon intensity of any of the major feedstocks, therefore fewer credits (i.e. revenue) generated in markets like California

More Virgin Oils Likely to be Costly

- Rabobank forecasts 12 million additional soybean acres required to meet crush demand for renewable diesel without harming US soybean exports.¹
- Farmers would want a **premium** of greater than 33% to bring new acreage into production.²



Higher Feedstock Cost Harms Profitability

- The price of feedstock has a high impact on variable COGS
- Renewable Energy Group, Inc, a leading RD refiner, estimates that a 10% increase in the cost of soybean oil would decrease profitability by 5.6%¹
- An increase of 33% in soybean oil prices, as previously estimated, would mean a **decrease of 18.6%** in RD profitability

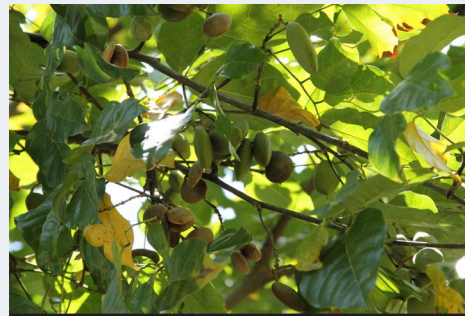
Change in soybean oil price	Decrease in RD profitability
10%	5.6%
20%	11.2%
30%	16.8%
40%	22.4%

Alternative Feedstocks Provide No Immediate Answers

Algae



Pongamia



Pennycress



Camelina



- Alternative feedstocks have been touted for next generation biofuels, and some suggest that their increased production could help fill the gap.
- However, as of 2021 the EIA reports only 800M lbs (~100MG) of “other” feedstocks; EPA states that algae oil is “not yet produced commercially”

New Projects Contain Feedstock Risk

- Financial projections must be based on future feedstock availability, not current pricing
- Projects that have long-term feedstock supply locked in at favorable economics will have a much better chance of profitability
- LEC has the expertise required to analyze renewable diesel projects and help determine whether the economics are sustainable



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