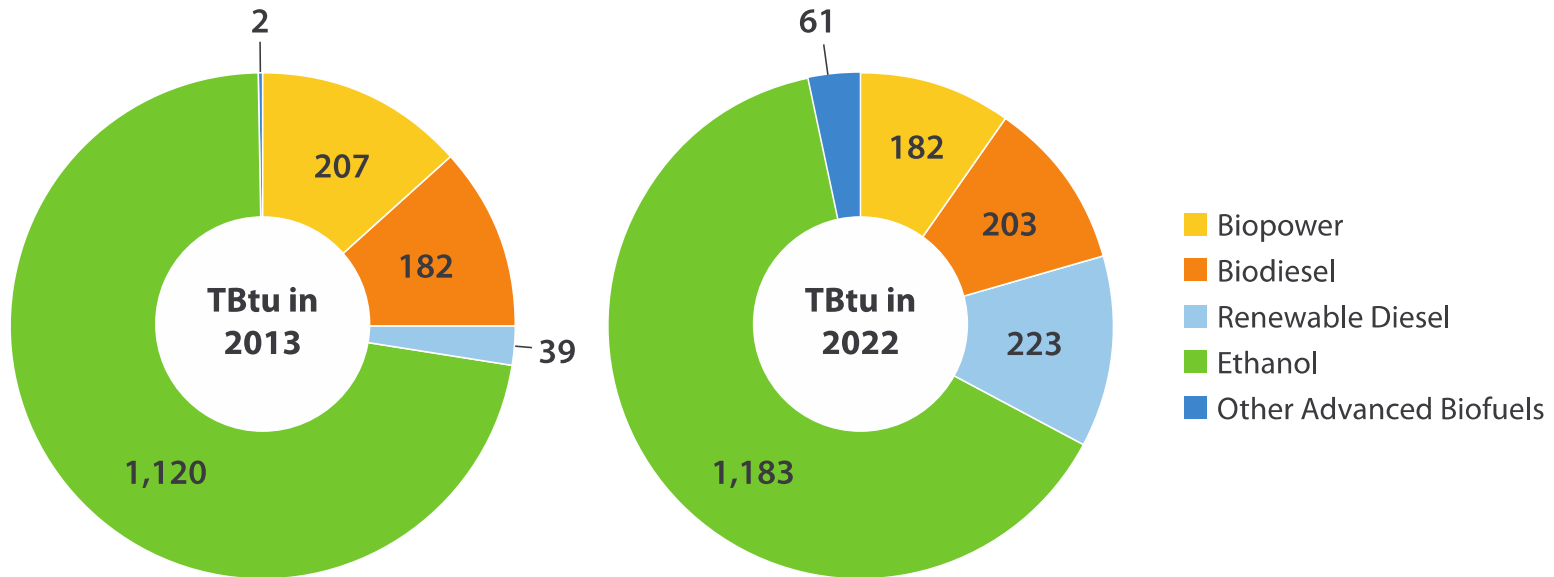


SAF Plants & Bioenergy Atlas

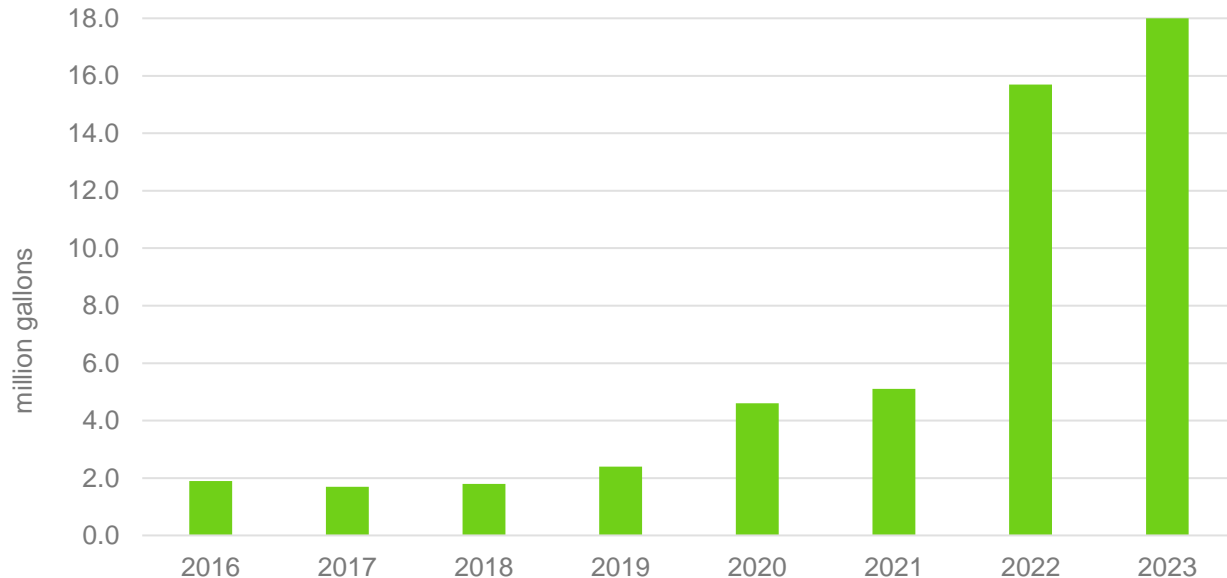
Kristi Moriarty
November 8, 2023

U.S. Bioenergy Market-Consumption



Sources: EPA (U.S. Environmental Protection Agency). 2023. "Public Data for the Renewable Fuel Standard." Accessed June 2023. <https://www.epa.gov/fuels-registration-reporting-and-compliance-help/public-data-renewable-fuel-standard>. EIA. 2023. "Monthly Energy Review." Tables 10.3, 10.4a, and 10.4b Accessed August 2023. <http://www.eia.gov/totalenergy/data/annual/index.cfm>. "Electric Power Monthly." Table 1.1A. Net Generation from Renewable Sources: Total (All Sectors), 2013-June 2023. Accessed August 2023. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_1_1_a

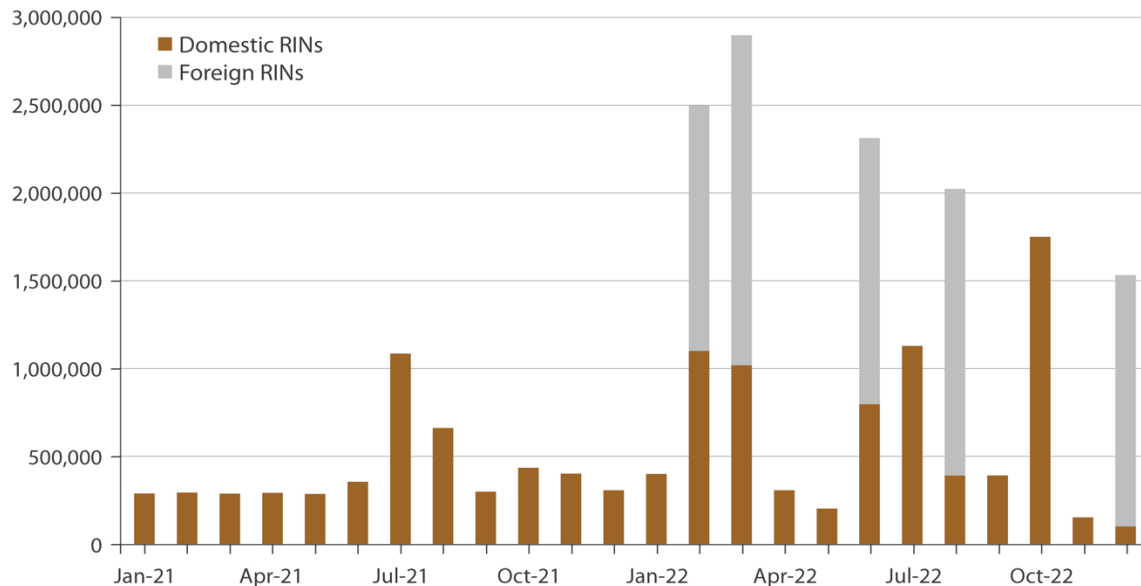
U.S. SAF Estimated Consumption



- 2023 through September
- ~0.07% of U.S. 2022 jet fuel consumption
- U.S. 2022 jet fuel consumption of 90 billion liters represented 28% of world use

EPA (U.S. Environmental Protection Agency). 2023. "Public Data for the Renewable Fuel Standard." Accessed June 2023. <https://www.epa.gov/fuels-registration-reporting-and-compliance-help/public-data-renewable-fuel-standard>.

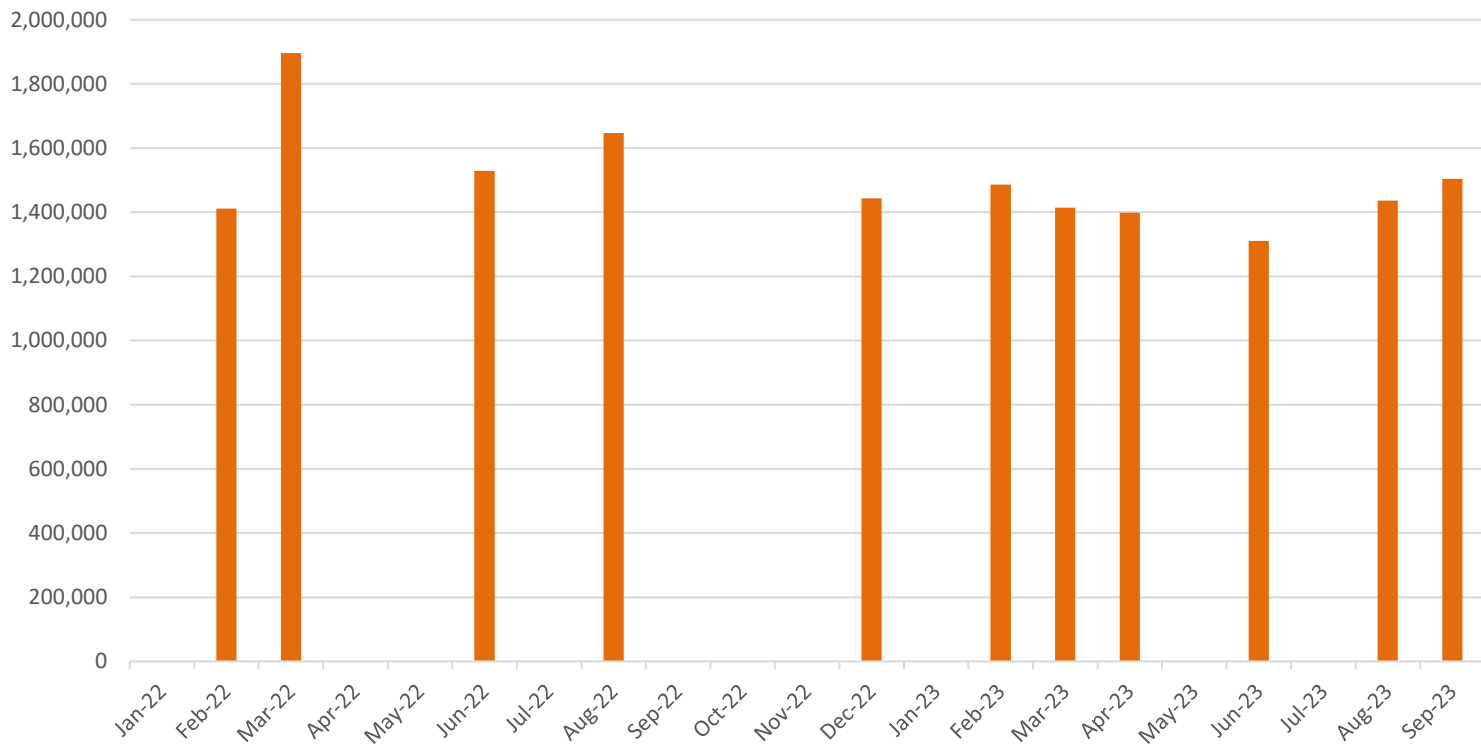
U.S. SAF Estimated Monthly Consumption



- SAF availability varies greatly by month
- Fluctuations in domestic RINs are a result of intermediary imported products being upgraded at US refineries into SAF

EPA (U.S. Environmental Protection Agency). 2023. "Public Data for the Renewable Fuel Standard." Accessed June 2023. <https://www.epa.gov/fuels-registration-reporting-and-compliance-help/public-data-renewable-fuel-standard>.

U.S. SAF Estimated Imports



EPA (U.S. Environmental Protection Agency). 2023. "Public Data for the Renewable Fuel Standard." Accessed June 2023.
<https://www.epa.gov/fuels-registration-reporting-and-compliance-help/public-data-renewable-fuel-standard>.

Other Regional Efforts



San Francisco
International
Airport



Not an all-inclusive list.

U.S. SAF Plants

Plant Name	Location	Technology	Feedstocks	Notes
Montana Renewables LLC	Great Falls, MT	hydrotreatment	waste fat, oil and grease	SAF output 2,000-15,000 barrels/day
World Energy	Paramount, CA	hydrotreatment	oilcrops, oils and fats	RD output 130,000 m3/yr
Gevo	Sisbee, TX	alcohol-to-jet	isobutanol	pilot; SAF output-265 m3/yr

U.S. Potential New SAF Plants

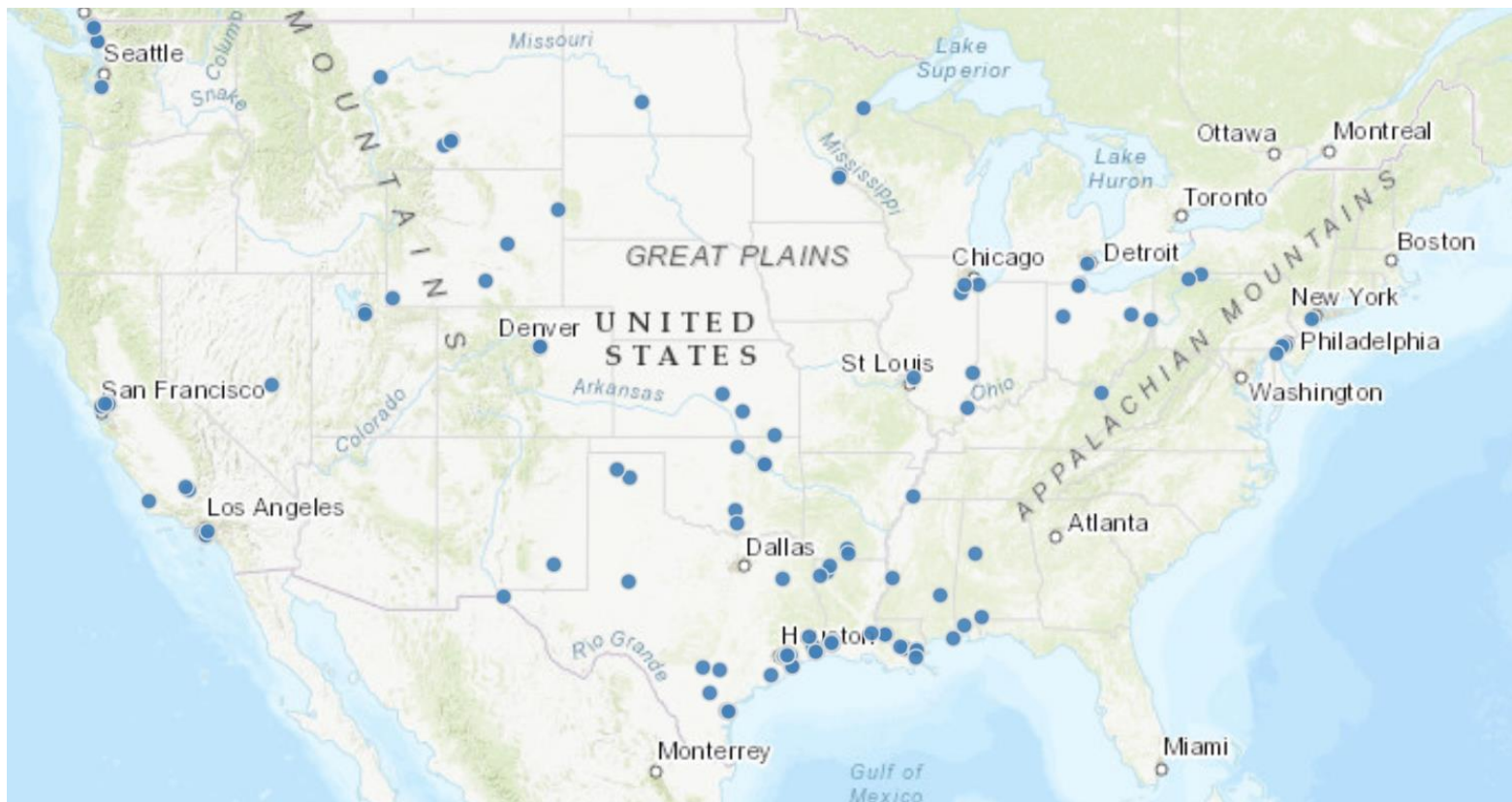
- Near term potential new plants
 - LanzaJet ethanol to jet pathway in Soperton, GA ~38 million liters of combined SAF and renewable diesel; startup expected soon
 - Phillips66 Rodeo refinery conversion in Arroyo Grande, CA ~3 billion liters renewable fuel capacity when finished; currently producing renewable diesel; \$1.25 billion; designed to produce SAF
 - Marathon refinery conversion in Martinez, CA ~2.8 billion liters; may produce SAF

U.S. Renewable Diesel Plants

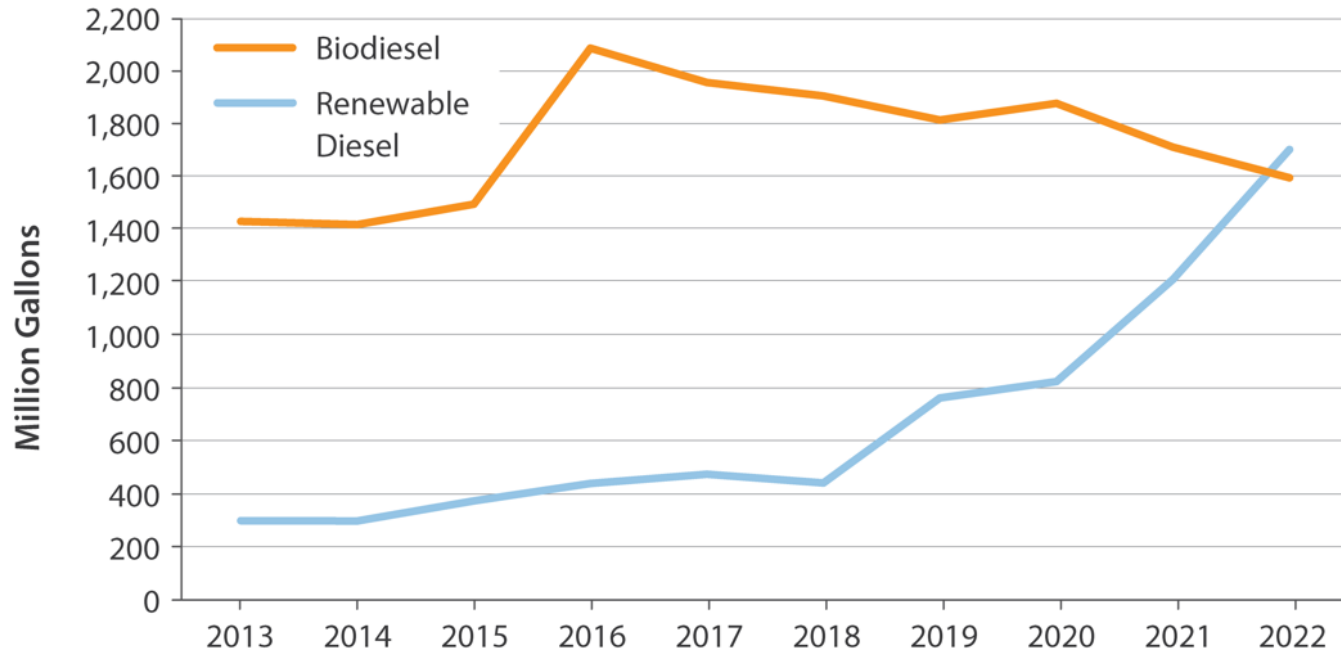
Plant	Location	Capacity (million gallons/year)
Altair Paramount LLC	Paramount, CA	42
BP Products North America ¹	Blaine, WA	111
Chevron USA Inc ¹	El Segundo, CA	31
Cheyenne Renewable Diesel Co LLC	Cheyenne, WY	92
CVR Renewables Wynnewood LLC	Wynnewood, OK	121
Dakota Prairie Refining LLC	Dickinson, ND	192
Diamond Green Diesel LLC	Norco, LA	982
Diamond Green Diesel LLC	Port Arthur, TX	537
HF Sinclair Renewables Holding Co LLC	Artesia, NM	141
Jaxon Energy, LLC	Jackson, MS	25
Kern Oil & Refining ¹	Bakersfield, CA	6
Montana Renewables LLC	Great Falls, MT	184
Phillips 66 Co	Rodeo, CA	180
Renewable Energy Group	Geismar, LA	101
Seaboard Energy Kansas LLC	Garnett, KS	85
Shell Oil Products U.S. ¹	Norco, LA	54
Wyoming Renewable Diesel Co	Sinclair, WY	117
Total		3,000
1-refineries co-processing petroleum and renewable feedstocks		

U.S. Energy Information Administration. (EIA). 2023. "U.S. Renewable Diesel Fuel and Other Biofuels Plant Production Capacity." August 7, 2023. Accessed August 2023. <https://www.eia.gov/biofuels/renewable/capacity/>.

U.S. Petroleum Refineries

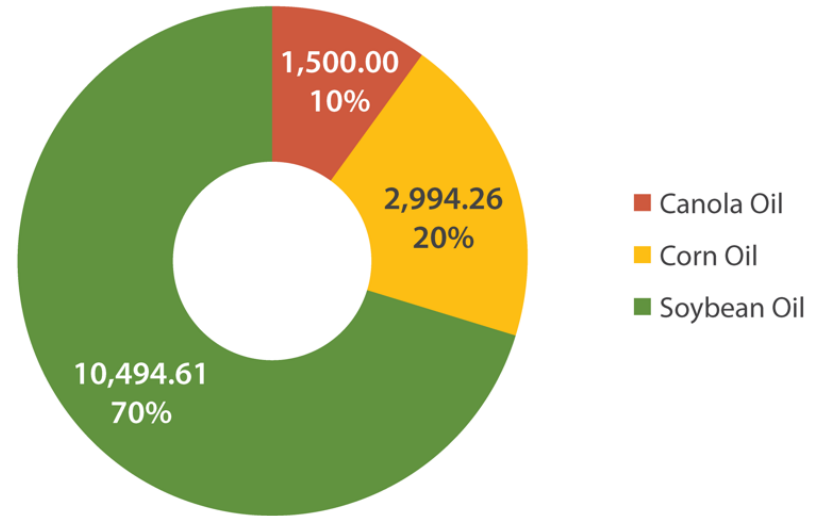
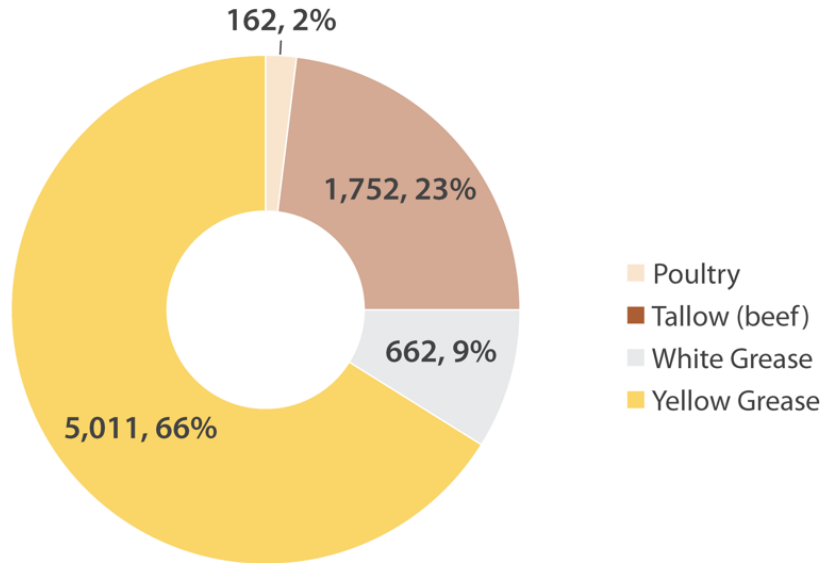


U.S. Renewable Diesel and Biodiesel Consumption

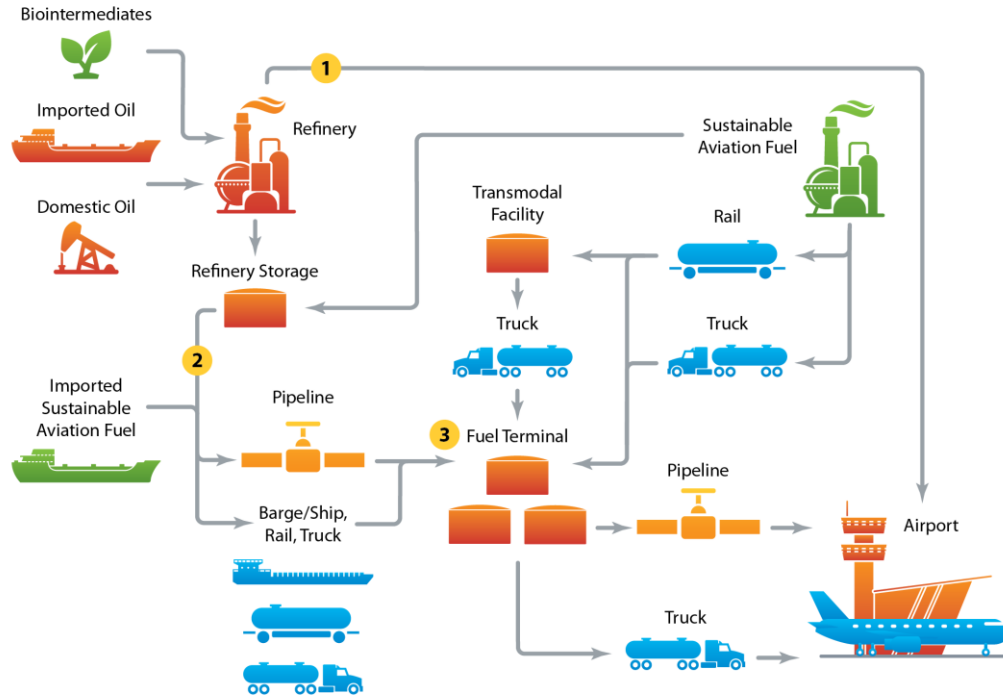


EIA. 2023. "Monthly Energy Review." Tables 10.4a and 10.4b Accessed August 2023.
<http://www.eia.gov/totalenergy/data/annual/index.cfm>.

U.S. Feedstock Use in Biodiesel, Renewable Diesel, and SAF (million pounds)

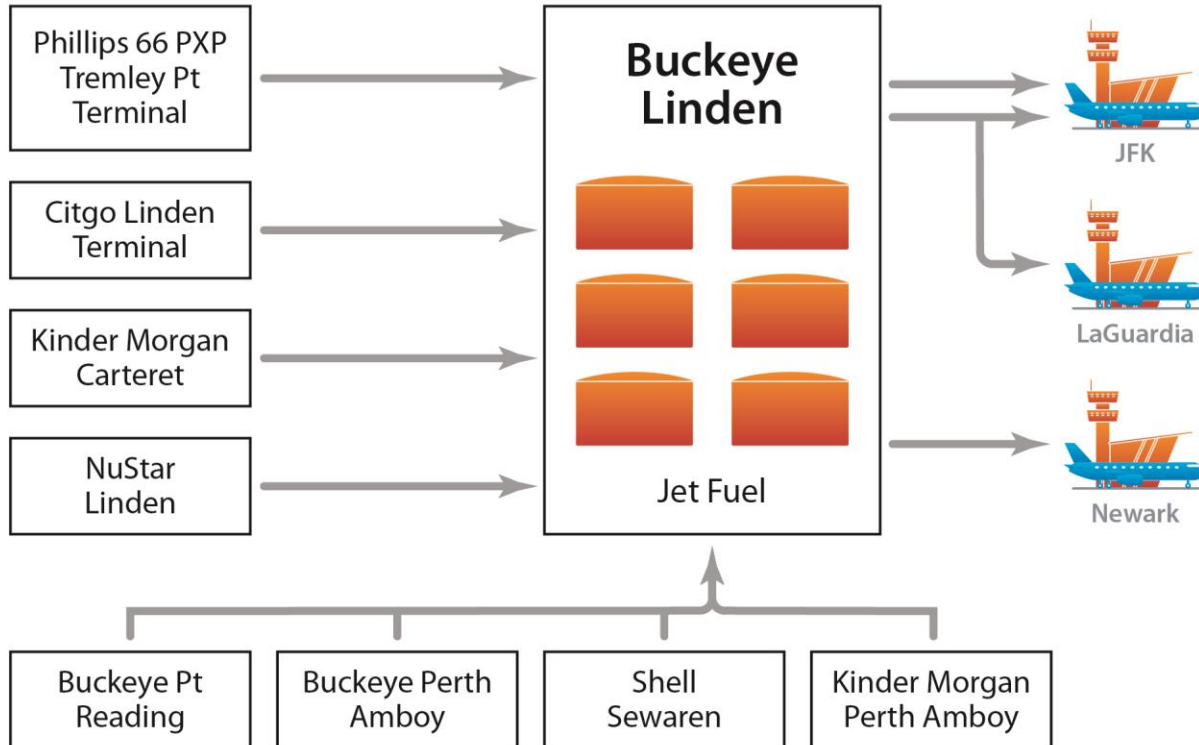


U.S. Infrastructure



- 1 A few refineries are directly connected to airports by pipeline.
- 2 In some cases, refineries may receive, blend, and certify third-party SAF.
- 3 SAF and conventional fuel can be blended at a terminal close to the airport or other terminals upstream.

PANYNJ Study-Logistics



Bioenergy Atlas

An interactive GIS based tool allowing user to view data on a map, download it, and estimate potential biofuel production

Bioenergy Atlas (old version)

Select and Query Data

Run Analysis



The Biofuels Atlas

Data Layers

Legend

Query

Turn Off All Layers

Feedstocks

Crops

Crop Residues

Bagasse

Barley Straw

Corn Stover

Grain Sorghum Stubble

Rice Straw

Wheat Straw

Wood

Biomethane

Billion-ton Study 2016

Energy Crop Yields

Bioenergy Plants

BioEnergy Sites

Natural Gas

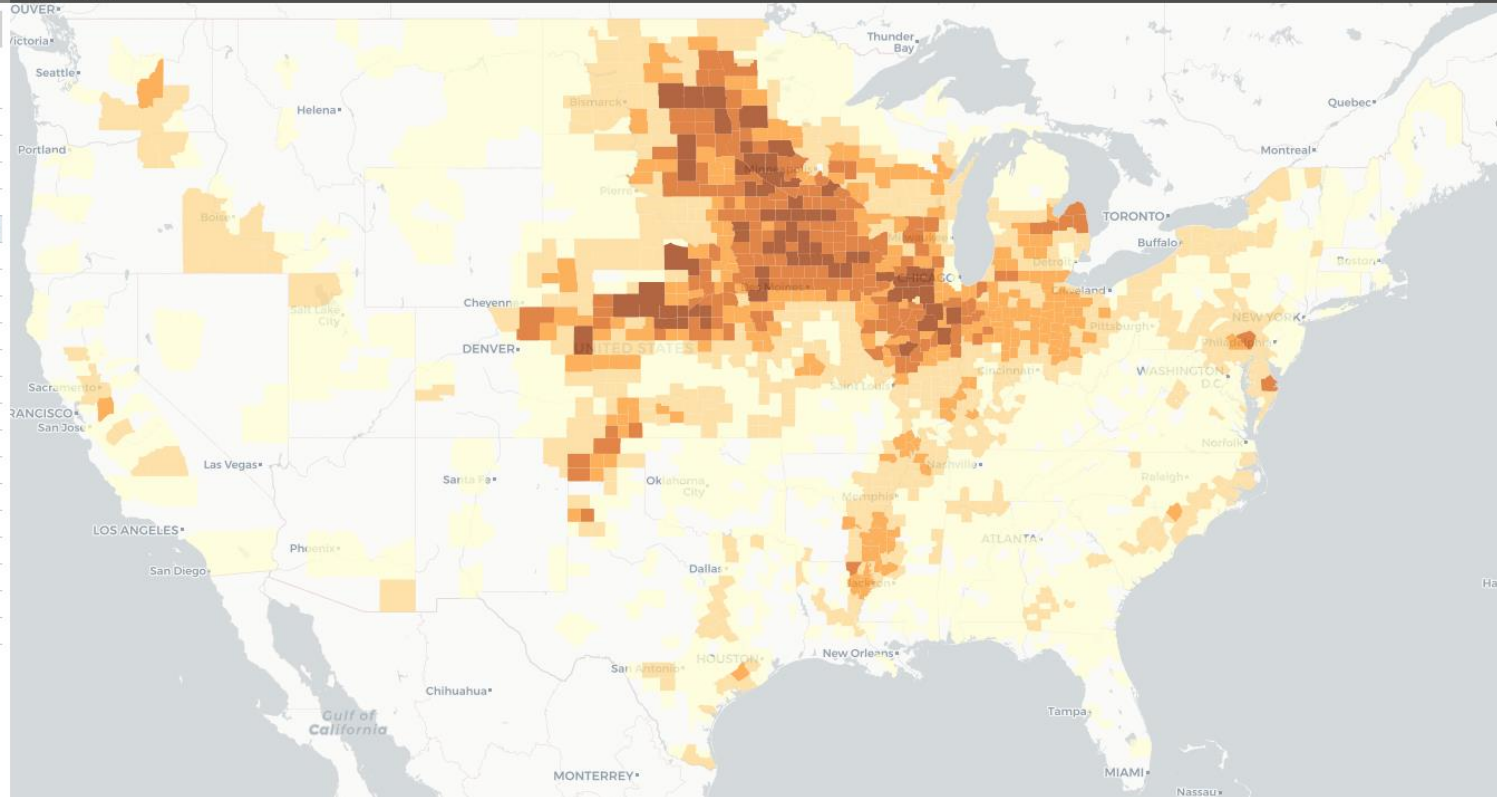
Petroleum

Other Power Plants

Alternative Fuel Stations

Vehicle Density

Infrastructure and Boundaries



Bioenergy Atlas (old version)

Bioenergy Atlas users can estimate biofuel or biopower production in an area.

Select and Query Data Run Analysis

Bioenergy Resource Analysis
Run an analysis on the amount of yield that can be produced in a specific area.

Incentives
Run an analysis on the incentives available in a specific area.

Results
These data show the amount of yield from each feedstock in the area you selected.

Feedstock	Dry Amt (tonnes)	Gallons	
Bagasse	0.00	0	Edit
Barley Straw	165.49	6,843	Edit
Forest Residues	321.97	10,126	Edit
Urban Wood and Sec. Mill Residues	38,370.46	1,577,026	Edit
Primary Mill Residues	504.38	20,730	Edit
Corn Stover	2,027,510.00	88,399,436	Close

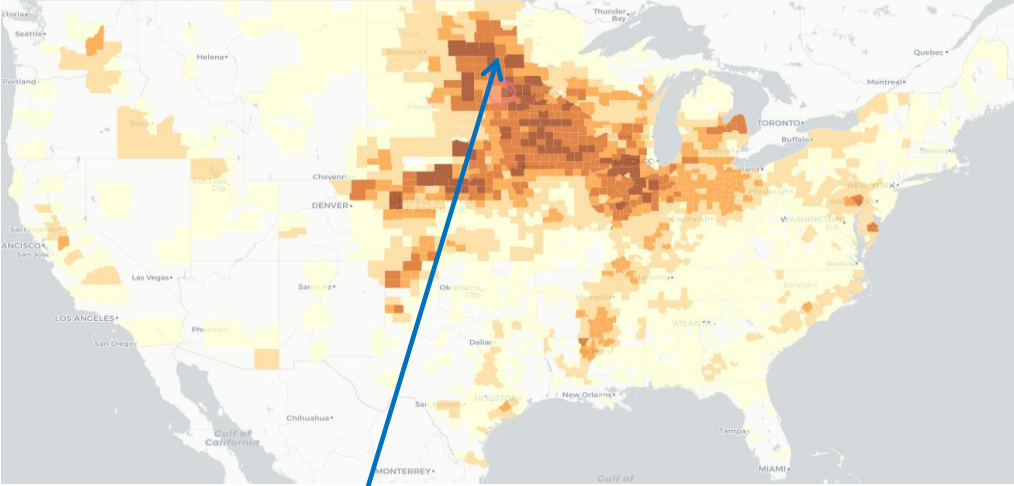
Available resource
 tonnes/year

Expected biofuel yield
 gallons/tonne

Percent of resource obtainable:
 %

Rice Straw	0.00	0	Edit
Sugar Beets	1,046,564.03	14,285,599	Edit
Sugarcane	0.00	0	Edit
Wheat Straw	85,726.99	3,189,044	Edit
Totals	3,499,163.32	107,488,804	

NREL The Biofuels Atlas



User drags a circle to select radius; feedstock data for all counties is used in calculations

Users can edit preloaded assumptions (based on theoretical ethanol yield calculator and biomass feedstock database).

<https://www.nrel.gov/gis/tools.html>

Bioenergy Atlas

CATEGORY	DATA LAYERS	SOURCE
FEEDSTOCKS		
Crops	sugarcane sugar beets	USDA NASS
Crop Residues	harvesting crop residues, processing crop residues (bagasse)	USDA-calculated
Biomethane	landfills, animal manure, Industrial, Institutional, and Commercial Organic Waste, wastewater treatment	Census Bureau, EPA, HSIP
Wood	forest residues, primary residues	USFS
Wood	urban wood, secondary mill residues	Census Bureau, industry data
Wet Wastes		BETO funded study
Billion-ton (future availability)		Billion Ton Study
Energy Crop Yields	energy cane, miscanthus, poplar, switchgrass, willow	Energy Biosciences Institute
BIOENERGY PLANTS		
Biofuels Plants	Biodiesel Plants	EIA
	Renewable Diesel Plants	EIA
	Sustainable Aviation Plants	NREL
	Ethanol Plants	EIA
Biopower Plants	landfill gas, MSW, wood and wood waste, other waste biomass, co-firing,	EIA
Pellet Plants	Densified Biomass plants	EIA
BIOENERGY Sites		
Bioenergy Sites	Bioenergy Sites	EPA

Bioenergy Atlas

NATURAL GAS, PETROLEUM, OTHER POWER PLANTS		
Natural Gas	liquefied natural gas import/export terminals	EIA
	Natural Gas Interstate and Intrastate Pipelines	EIA
	Natural Gas Trading Hubs	EIA
	Natural Gas Processing Plants	EIA
	Natural Gas Underground Storage Facilities	EIA
	Natural Gas Power plants	EIA
Petroleum	Petroleum Refineries	EIA
	Petroleum Product Pipelines	EIA
	Petroleum Product Terminals	EIA
	Crude Oil Pipelines	EIA
	Crude Rail Terminals	EIA
	Oil Power Plants	EIA
Other Power Plants	coal, geothermal, hydro, nuclear, other, solar, wind	EIA
ENVIRONMENTAL IMPACTS		
Environmental Impacts	Carbon Monoxide (1971 standard)	EPA
	Lead (2008 Standard)	EPA
	Lead (1978 Standard)	EPA
	Nitrogen Dioxide (1971 Standard)	EPA
	8 Hour Ozone (2008 Standard)	EPA
	PM 2.5 (2006 Standard)	EPA
	PM 2.5 (1997 Standard)	EPA
	Sulfur Dioxide (2010 Standard)	EPA
	1 Hour Ozone (1979 Standard)	EPA
PM 10 (1987 Standard)	EPA	

Bioenergy Atlas

VEHICLE DENSITY		
Vehicles	FFV	Experian
	Diesel	Experian
OTHER INFRASTRUCTURE		
Airports		
Highways		
Powerlines		
Railroads		
Tribal Boundaries		
Waterways		