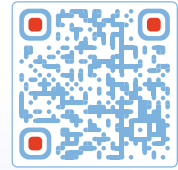


Follow the QR code for other factsheets, background information and references:



# RENEWABLE DIESEL AND RENEWABLE JET FUEL

Biofuels are liquid fuels made from plant and animal matter rather than petroleum.

The fuels referred to as 'renewable diesel' and 'renewable jet' are hydrocarbon fuels produced by treating vegetable oils and/or animal fats with hydrogen.

These fuels are chemically similar to fossil fuels, and can be collectively termed 'HVO fuels' (standing for hydrotreated vegetable oil).

They can be used in existing engines up to 100% for renewable diesel and 50% for renewable jet.

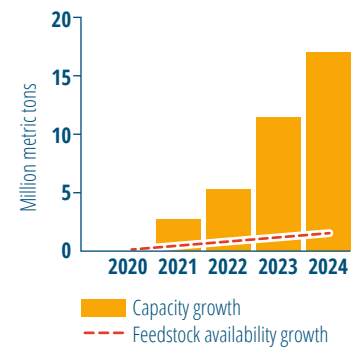
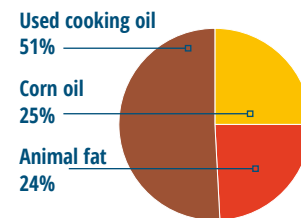
## PRODUCTION AND FEEDSTOCKS

- ◆ U.S. production capacity was **1.7-1.9 billion gallons** in 2022, with most fuel produced as renewable diesel.
- ◆ There is a drive to increase the output of renewable jet fuel.
- ◆ Currently the majority of HVO fuel is made from low-value wastes and by-products, but...

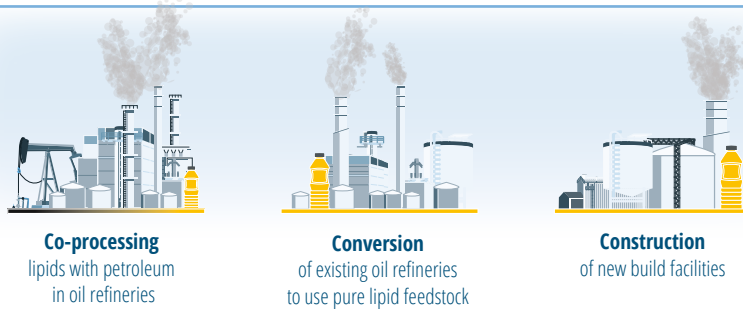
...availability is limited, and growth will require the use of crop-based oils like soy that would have gone to the food market.



### FEEDSTOCKS FOR RENEWABLE DIESEL AND JET



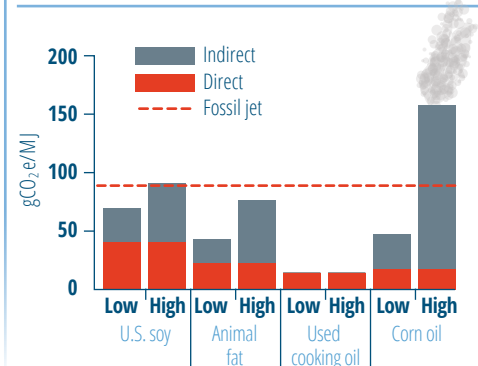
### CAPACITY CAN BUILD UP IN THREE WAYS



## GREENHOUSE GAS (GHG) EMISSIONS

- ◆ HVO fuels can be produced with low net GHG emissions – but this is not guaranteed.
- ◆ Net emissions are primarily driven by feedstock use, but also include energy consumed for processing, transport and distribution.
- ◆ 'Indirect' emissions are associated with increasing feedstock production or replacing feedstock in existing uses, including land use changes.
  - ◇ Indirect emissions are significant but are subject to uncertainty.
- ◆ When including indirect emissions, HVO fuels could have higher GHG emissions than fossil fuels.

### LIFECYCLE GREENHOUSE GAS EMISSIONS FOR RENEWABLE JET FUEL with low and high indirect emissions estimates



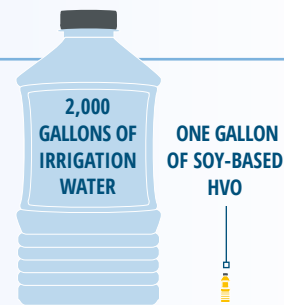
## INDIRECT EFFECTS: DISPLACEMENT

Feedstocks classed as wastes or by-products are often treated as environmentally 'free' resources. But in some cases diverting these materials from existing uses leads to demand for replacement materials. Emissions from producing those replacement materials can **reduce or eliminate the potential GHG benefit from HVO fuels.**



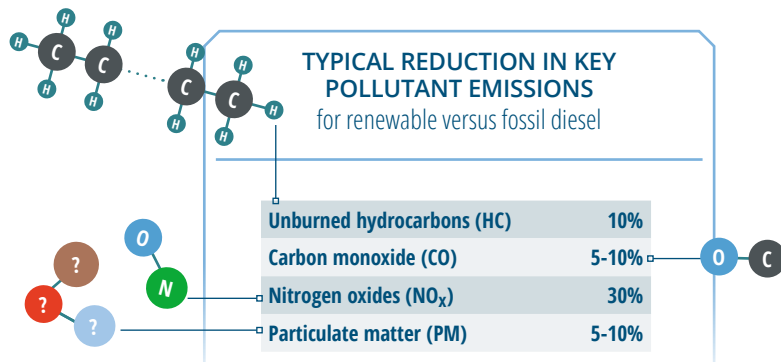
## WATER AND DOMESTIC LAND USE

- ◆ Production of crop feedstocks comprises around 98% of crop biofuels' water footprint.
- ◆ About 10% of U.S. soy is irrigated; **one gallon of soy-based HVO fuel requires on average 2,000 gallons of irrigation water** along with 2,000 gallons of rain water.
- ◆ Recent U.S. soy/corn expansion has come predominantly from grasslands (88%), but also converted about 275,000 acres of wetland (3%) and 180,000 acres of forest (2%).



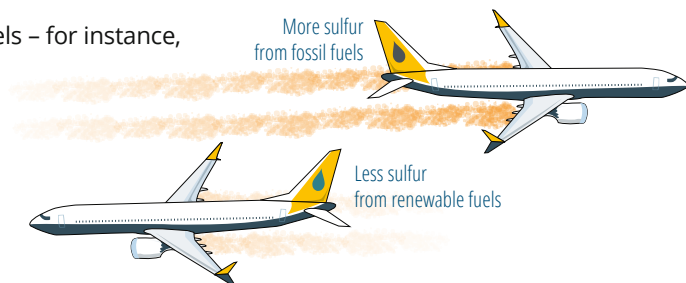
## AIR POLLUTION FROM FUEL USE – RENEWABLE DIESEL

- ◆ Road vehicles burning renewable diesel produce lower levels of key pollutants than fossil diesel.
- ◆ Biofuels naturally contain almost no sulfur.
- ◆ These fuels cannot reduce emissions to the level achieved by zero emission vehicles (e.g. battery electric).
- ◆ The benefit could be offset if fuel suppliers blend HVO fuels with dirtier-than-normal fossil fuels.



## AIR POLLUTION FROM FUEL USE – RENEWABLE JET

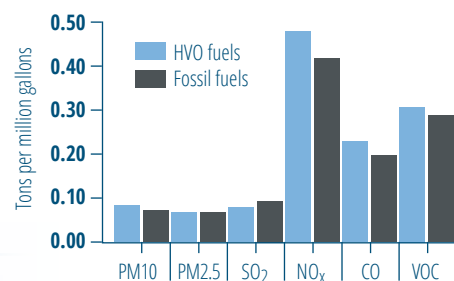
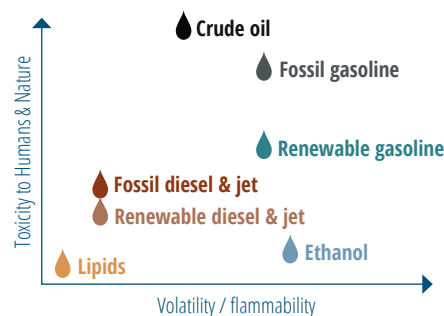
- ◆ Pollution standards for fossil jet fuel are less strict than for road fuels – for instance, in the U.S. sulfur levels are 40x higher for jet than fossil diesel.
- ◆ Resulting U.S. mortalities from particulate matter exposure are estimated in the hundreds annually.
- ◆ Renewable jet contains lower sulfur and less aromatic hydrocarbons, and this is linked to lower air pollution.
- ◆ Renewable jet use can therefore benefit air quality around airports.
- ◆ Noise from jet turbines is unaffected by the fuel.
- ◆ Farming feedstocks such as soy oil are associated with additional air pollution, and would make HVO fuels worse for air pollution overall than fossil diesel or jet fuel.



## HAZARDS ARISING FROM PRODUCTION AND SUPPLY

- ◆ HVO-fuel feedstocks are low toxicity (some are edible); crude oil on the other hand poses exposure hazards to humans and nature.
- ◆ Refined fossil fuels are generally 'dirtier' than their renewable counterparts: for instance, they contain more aromatic hydrocarbons linked to long-term health risks like cancer.
- ◆ Storage and handling safety measures differ between fuels – e.g. mechanisms for flaring off-gases, ecological protections, and worker exposure limits.

### ILLUSTRATIVE MAPPING OF TOXICITY AND FLAMMABILITY for fuels and feedstocks



## EMISSIONS OF AIR POLLUTANTS FROM REFINERIES

Reported air pollution levels from oil refineries and HVO plants are similar per gallon of fuel output.