

# **Renewable Diesel vs Biodiesel**

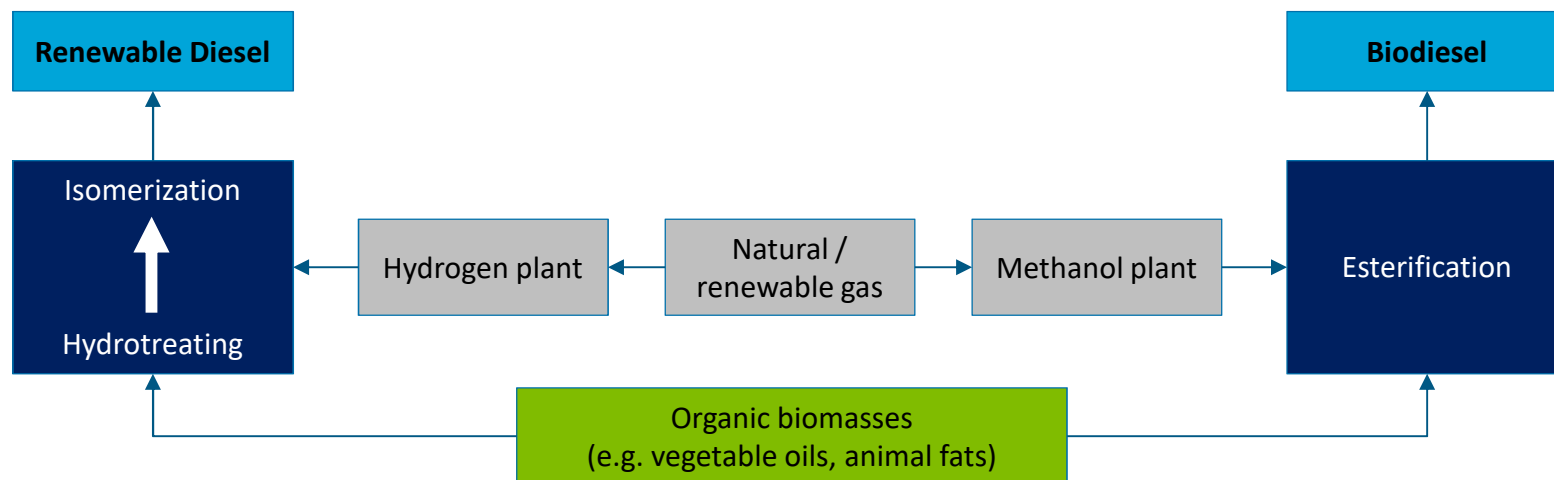
# Renewable diesel and biodiesel can be made from similar feedstocks, but utilize different processes

## Renewable Diesel Production

- Renewable diesel is also known as Hydrogenated Vegetable Oil (HVO)
- Colorless, odorless fuel that has the same chemical composition as petroleum diesel, no matter the feedstock
- Produced from two refinery processes:
  - Hydrotreating: removes sulfur and other contaminants such as nitrogen and metals
  - Isomerization: compounds are molecularly rearranged, typically straight chain molecules to branched molecules
- Capital intensive

## Biodiesel Production

- Biodiesel is also known as Fatty Acid Methyl Ester (FAME)
- Quality is dependent on the type of raw materials used
- Produced by esterification – a reaction of an alcohol with an acid
- Less capital intense than renewable diesel production
  - Operates at a significantly lower pressure and temperature



# Renewable diesel has superior performance

| Property                 | Renewable Diesel                                     | Biodiesel  |
|--------------------------|--|--|
| Energy (BTU) content     | ✓ Same as diesel fuel                                | ✗ Lower than diesel fuel   |
| Cold temperature issues  | ✓ None   | ✗ Issues with freezing or gelling at cold temps (cloud/pour point) |
| NOx tailpipe emissions   | ✓ Lower than diesel fuel                             | ✗ Higher than diesel fuel  |
| Stability                | ✓ No issues  | ✗ Degrades over time   |
| Allowed in pipelines     | ✓ Yes  | ✗ Limited  |
| Chemical makeup          | ✓ Pure hydrocarbon                                   | ✗ 11% oxygen by weight; causing performance limitations            |
| Practical limit in blend | ✓ No limit w/proper labeling; 85% sold in California | ✗ 5% to 7%; Some B20 and B30 seasonally                            |

**Biodiesel has limitations driven by its chemical characteristics**

# Renewable diesel is compatible with existing infrastructure, biodiesel has limitations



|                  | Pipelines  | Storage  | Transit  | Blending   | Automobiles   |
|------------------|--|--|--|--|---|
| Biodiesel        | Affinity for water makes less suitable for transit by pipeline; cannot ship in pipelines carrying jet fuel | Microbial growth in a tank during storage<br>Cannot be stored for long periods of time<br>Heat tracing required in cold climates | Must be trucked separately from petroleum fuels<br>Heating required in cold climates | Contains a typical maximum blend of 5%<br>6-20% blends are no longer considered "diesel" must meet separate specifications | Not compatible with all engines<br>Blends above ~5% are dependent on vehicle make/model due to potential engine problems and/or filter clogging |
| Renewable diesel | A "drop-in" fuel, completely compatible in all existing pipeline infrastructure                            | Excellent storability, like petroleum diesel   | Can be trucked and transported with petroleum diesel                                 | Can be blended in any ratio, 0-100%  | Can be used in any engine, no modifications or changes required   |

**Renewable diesel provides enhanced flexibility in existing infrastructure, while biodiesel requires additional investment**