



# Bioenergy glossary

## Advanced biofuels

Liquid or gaseous fuels produced through innovative conversion technologies that deliver high-quality, drop-in substitutes for conventional fossil fuels - such as renewable diesel, sustainable aviation fuel, advanced bioethanol, renewable methanol - designed for use in existing engines, aircraft, and infrastructure without blending limits.

Advanced biofuels overcome the limitations of first-generation biofuels by using more sustainable feedstocks and further reducing greenhouse gas emissions.

## Agricultural residues

Cereal straw (wheat, oat, barley, canola) and oat husk, which are mostly left on the fields after harvests and traditionally used for fodder, burnt or sent to landfill. Agricultural residues can be used as feedstock for second generation biofuel production.

## Alcohol to Jet (ATJ)

An approved pathway to produce drop-in jet fuels from sustainably produced alcohols. In the ATJ production pathway, biomass is hydrolysed to produce fermentable sugars. The sugars are fermented to produce alcohols, which are then dehydrated, oligomerized, hydrogenated and fractionated to produce alcohol-to-jet synthetic paraffinic kerosene (ATJ- SPK). This blend stock fuel is approved under aviation standards and can be blended with conventional jet fuel to 50%.

## Anaerobic digestion

The process where moist organic matter is broken down by micro-organisms in the absence of oxygen to produce digestate and biogas. The digestate retains valuable nutrients and can be used as a soil improver or natural fertiliser. The biogas is comprised of 40-70% methane and can be used as a renewable energy source. The facility used to make digestate and capture the biogas is called a biodigester.

## Biochar

A carbon-rich material created by heating organic biomass (i.e. wood, crop residues) in a low-oxygen environment called pyrolysis. It looks like charcoal but is specifically produced for environmental and agricultural purposes. Biochar can increase soil fertility, water holding capacity and crop productivity when applied to agricultural soils. Can also produce metallurgical grade char.

## Biodiesel

A renewable fuel produced through transesterification of oils and fats. Biodiesel is commonly sold in blends with conventional diesel and can require little or no engine modification depending on the blend ratios.

## Bioenergy

A form of renewable energy generated from the conversion of biomass into heat, electricity, biogas and liquid fuels.

Advanced bioenergy is next-generation technologies and processes that produce energy from biological sources (biomass) in a more efficient, sustainable, and low-carbon way compared to traditional bioenergy methods. It is produced from lignocellulosic biomass (i.e. agricultural residues like crop straw, sugar cane bagasse; and forestry thinning), non-food crops (i.e. pongamia, algae), or municipal or industrial waste streams. Benefits of advanced bioenergy include lower CO<sub>2</sub> emissions; minimisation of Indirect Land-Use Change (ILUC) and improved sustainability outcomes.

## Biofuel

A generic term for a fuel derived from biological matter, or biomass. It is generally used for liquid vehicle/transport fuels. Ethanol and biodiesel are common biofuels which are generally blended with conventional fuel to lower carbon emissions. Emerging second generation biofuels include renewable diesel and Sustainable Aviation Fuel (SAF).

## Biogas

A mixture of methane (40-70%), carbon dioxide and small quantities of other gases produced by anaerobic digestion of organic matter in an oxygen-free environment. The precise composition of biogas depends on the type of feedstock and the production pathway, biodigesters, landfill gas recovery systems or wastewater treatment plants.

## Biomass

Organic material from living organisms (plants and animals). The most common biomass feedstocks (materials) are energy crops, agricultural and forestry residues, industrial and organic waste and algae.

## Biomass certification schemes

Certify the sustainability and environmental credentials of biomass feedstocks. Examples include the International Sustainability and Carbon Certification (ISCC), Biomass Biofuels Sustainability Voluntary Scheme (2BSVs) certifications for crops entering the EU biofuel market, Rainforest Alliance certification for forestry products, the Green Palm or Roundtable on Sustainable Palm Oil (RSPO) certification for palm oil.

## Biomass conversion technology

Biomass conversion technologies utilise mechanical, thermal, chemical, biochemical or electrochemical processes to decompose and refine biomass into biofuels. Essentially the technology rearranges the biomass into refinable hydrocarbons. Examples include:

- Gasification: Converts biomass into syngas for energy and fuel.
- Pyrolysis: Produces bio-oil and biochar
- Anaerobic digestion: Generates biogas from organic waste
- Biochemical processes: Advanced fermentation for biofuels.

### **Biomethane or renewable gas**

Gaseous fuels produced from renewable sources used for heating, electricity generation, transport, or as feedstock for industry. Biomethane is produced by upgrading biogas produced at landfill sites by anaerobic digestion of municipal solid waste (e.g. food waste, agricultural residues, manure, wastewater sludge), followed by a methanation process which removes impurities (water vapor, hydrogen sulfide, siloxanes) and separates the biogenic CO<sub>2</sub> from the methane.

### **Bio-oil (pyrolysis oil or bio-crude)**

A liquid biofuel produced by pyrolysis. The exact chemical nature of each bio-oil is dependent on the biomass feedstock.

### **Cellulosic biomass**

Any organic matter; includes agricultural crops and trees, wood and wood waste and residues, plants, grasses, residue fibres, and animal and municipal wastes.

### **Co-firing**

The partial substitution of coal with biomass to reduce greenhouse gas and SO<sub>x</sub> (sulfur oxide) emissions. There are 3 methods for co-firing; direct co-firing where the biomass and coal are burned in the same furnace, indirect co-firing which involves prior gasification of the biomass and parallel co-firing which involves the installation of a separate biomass boiler allowing a high amount of biomass to be used.

### **Combined Heat and Power (CHP)**

Also known as cogeneration – CHP technologies generate electricity and utilise the waste heat from the power generation process for heating and/or cooling. CHP are often used in anaerobic digestion facilities to burn the biogas for electricity and heat generation.

### **Digestate**

The solid sludge left behind in an anaerobic digester. The digestate retains valuable nutrients and can be used as a soil improver or natural fertiliser.

### **Energy crops**

A crop that is grown because it can be used directly or processed into fuel. Sustainable energy crops must meet specific requirements for land management as to not impact soil, water, carbon, cultural and conservation values.

### **Ethanol**

An alcohol used as a blending agent with petrol – up to 10% - to increase octane and cut down carbon monoxide and other smog-causing emissions.

Ethanol (CH<sub>3</sub>CH<sub>2</sub>OH) is a renewable fuel made from plant materials, most commonly corn, sugarcane or sweet sorghum. Second-generation feedstocks include:

- Agricultural residues: cereal straw
- Forestry residues: wood chips, sawdust
- Dedicated energy crops: pongamia, hemp

## Fischer–Tropsch

The process of reacting synthetic gas (a mix of carbon monoxide and hydrogen).to produce high quality hydrocarbon liquids.

## Forestry residues

The by-products from forest harvesting and silviculture activities, also known as ‘slash’, in mechanical tree-felling operations. It generally consists of branches, tops and un-merchantable wood left in the forest after the cleaning, thinning or final felling of forest stands.

## Gasification

The complete thermal (heat) breakdown of biomass into a combustible gas - syngas or synthetic gas - in a reactor or gasifier. Syngas is predominately a mixture of hydrogen and carbon monoxide.

## Hydroprocessed Esters and Fatty Acids (HEFA)

Produced by hydroprocessing triglycerides and free fatty acids—typically derived from renewable lipids (oils, animal fats and used cooking oils - UCO). Hydroprocessing reacts the feedstock with hydrogen under high pressure and temperature in the presence of a catalyst. These high-quality paraffinic hydrocarbons can be refined into:

- Sustainable Aviation Fuel (SAF) - meeting ASTM D7566 specifications
- Renewable diesel - drop-in replacement for fossil diesel
- Naphtha and other co-products

HEFA fuels are fully compatible with existing engines and infrastructure, offering similar energy density and performance to conventional jet fuel while significantly reducing lifecycle greenhouse gas emissions. These are free of aromatics, oxygen and sulphur and have high cetane ratings - a measure of the ignition quality. Biofuels produced through HEFA offer benefits compared with earlier biofuels - reduced NOx emissions, and better storage stability and cold flow properties.

## Hydrotreated Vegetable Oils (HVO)

A type of renewable diesel fuel produced by treating vegetable oils or animal fats with hydrogen in a process called hydrotreatment, the same feedstock as HEFA. This process removes oxygen and other impurities, converting the oils into hydrocarbons that closely resemble conventional fossil diesel. Primarily used as a drop-in fuel for diesel engines, meeting EN 15940 specifications.

## Indirect Land-Use Change (ILUC)

Relates to the unintended environmental impacts of repurposing land to produce biofuel crops.

## Lignocellulosic biomass

Material that is mostly composed of cellulose, hemicellulose, and lignin. Lignocellulosic biomass is the most abundant type of biomass and includes a wide variety of biomass types including grasses, wood, energy crops, and agricultural and municipal wastes.

## Municipal Solid Waste (MSW)

Solid waste collected by the municipality (local government) or disposed of at the municipal landfill site. Includes residential, industrial, institutional, commercial, municipal, and construction and demolition waste.

## Naptha

A light, volatile hydrocarbon mixture produced as a co-product from processes like Fischer–Tropsch synthesis and HEFA. It’s not a single compound but a blend of hydrocarbons, typically in

the C5–C12 range, used as a renewable petrochemical feedstock or blended into gasoline to improve the octane rating.

## Pyrolysis

A thermal decomposition process where organic materials are broken down into smaller molecules by heating them (typically between 300-900°C) in the absence of oxygen (or in very low oxygen conditions). This prevents combustion and instead produces useful products like gases, liquids, and solids.

Pyrolysis is focussed on the production of bio-oil, syngas and biochar

## Renewable diesel

A biofuel produced from biomass through hydrotreating, gasification, pyrolysis, and other biochemical and thermochemical technologies. It meets international ASTM D975 specification for petroleum diesel and can directly substitute for diesel as it is indistinguishable in its chemical and physical properties. Renewable diesel can directly substitute conventional diesel and does not require blending. Although renewable diesel and bio diesel are both made from renewable sources, they differ in chemical structure and are produced using different methods.

## Sustainable Aviation Fuel (SAF)

An aviation biofuel or bio-jet fuel used to power aircraft which is very similar in its chemistry to traditional fossil jet fuel. SAF is currently produced from a range of biomass sources and processes. It is approved for use as an aviation fuel under ATSM D7566, allowing up to 50 percent blending with conventional jet fuel.

## Syngas or synthetic gas

Mixture of CO<sub>2</sub>, H<sub>2</sub>, CH<sub>4</sub>; used for energy or chemical synthesis.

## Timber residues

Wood processing or timber residues are the by-products of sawmills and other wood product manufacturing facilities.

## Waste to Energy (WtE)

A process where **non-recyclable waste materials** (municipal solid waste) are converted into **usable energy**, steam, heat or synthetic gas which can be used directly or to generate electricity or synthetic fuels. Instead of sending waste to landfills, WtE technologies recover energy, reducing environmental impact and generating renewable energy.

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