CANDRIAM

# Green innovations series: Biofuels

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Marketing communication

# About

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Marouane joined Candriam in 2022 as Senior Fund Manager in the Thematic Global Equity Team, focusing on climate action and the effort to limit global warming.

He began his career in 2015 at Edmond de Rothschild AM in Paris as an Equity Analyst on environment-related themes. From 2018 to 2022 he co-managed a climate solutions-focused global mandate and an energy evolution fund which focused on the ongoing climate related energy transition. Beginning in 2020 he also became lead manager of the EdR Green New Deal fund, a global equity climate fund.

Marouane holds a Masters in Financial Markets and Risk Evaluation from the Toulouse School of Economics, where he is an external lecturer on Sustainable Finance and ESG analysis. He became a CFA Charterholder in 2018.

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# Green innovations series:

## Biofuels

**While electrification is arguably the best green option for cars light-duty vehicles over the longer term, *biofuels* can provide a low-carbon solution for *heavy-duty trucks, ships, and aircraft* -- which have fewer viable medium-term decarbonization options.[1]**

More than 40%[2] of global oil production is supplied by the 'OPEC +' nations. The risks of a market in which supply is controlled by a few sellers and demand is inelastic are obvious, and geopolitics merely adds to those. Within the European Union, almost 60%[3] of oil demand is consumed by transportation, making decarbonization and energy sovereignty top


1. *Hydrogen, which we will discuss in another edition of this series, is a long way off.*
2. *IEA – Oil market report Oil Market Report - March 2023 – Analysis - IEA, accessed 23 May, 2023.*
3. *Eurostat, as of 2021. Oil and petroleum products - a statistical overview - Statistics Explained (europa.eu) Accessed April, 2023.*

## The future has arrived

Biofuels date to the early days of the automobile. Indeed, Rudolf Diesel's engine was initially designed to run on peanut oil! Three decades later and on the other side of the Atlantic, Henry Ford proclaimed that ethanol produced from agricultural crops would be 'the fuel of the future.' Critics added, 'and it always will be.'

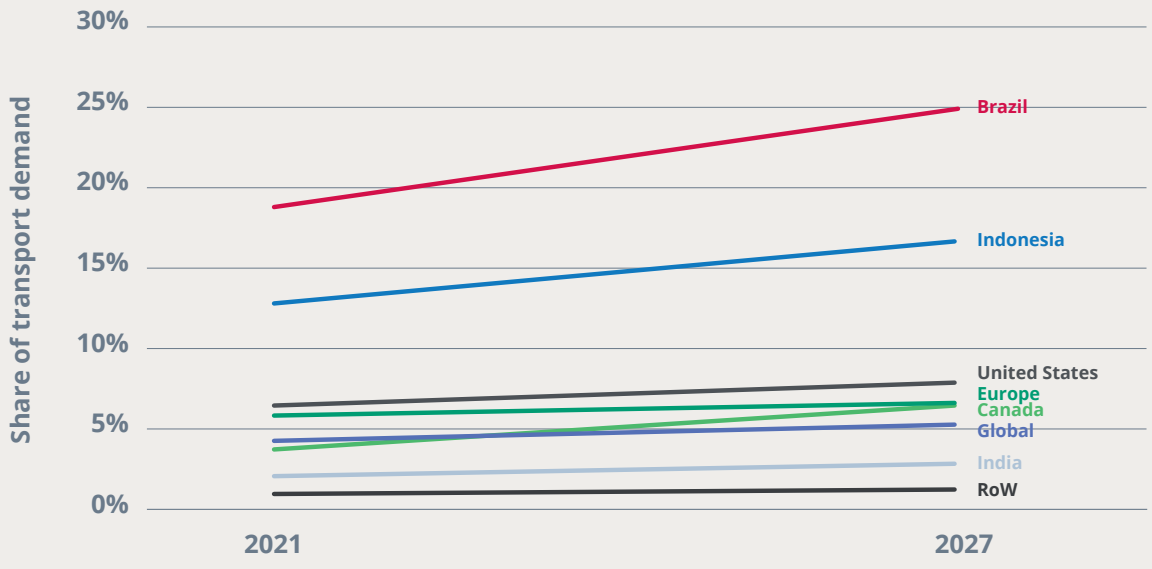
Biofuels are likely to become a significant lever for the energy transition. While rarely discussed, they are already widely used in our daily lives. When you refuel at a gas station, you are probably purchasing a mixture of diesel and biodiesel (the European B7 diesel contains 7% biodiesel) or gasoline and ethanol (The E10 gasoline contains up to 10% ethanol).[4]

However, due to the abundance and low cost of petroleum, biofuels were largely ignored in favour of fossil fuels during the 20th century. It was not until the oil crises of the 1970s that the desire to reduce dependency on oil imports sparked renewed interest in biofuels.

The market is already significant. Biofuels represent 6.8%[5] of the 2020 fuel consumption for road transportation in Europe. In the US it is already 10% of gasoline consumption. In California, thanks to the LCFS program, or Low Carbon Fuel Standard, renewable diesel now makes up 20% of total diesel demand.

The IEA, or International Energy Agency, expects biofuel growth to reach 20%[6] of transport energy within five years, driven by policies such as the EU's target of 14% biofuel utilization in transport by 2030. The US offers to drive higher penetration, while China, Brazil, Indonesia, and India are also notable growth markets. The IEA estimates that biofuels could contribute as much as 15% of global transport energy use by 2030.

**Figure 1 Projected biofuel share of transport demand, selected countries**




*Source: IEA, Paris. Renewables 2022, Analysis and forecast to 2027, accessed 22 May, 2023. Used under Creative Commons license, format adapted.*

*4. H"Much of petroleum diesel fuel sold in the United States actually contains up to 1% biodiesel because of biodiesel's lubrication qualities." U.S. Energy Information Administration, 29 June, 2022. Biofuels explained - use and supply. Accessed 22 May, 2023.*

*5. European Environment Agency, Greenhouse gas intensities of transport fuels in the EU in 2020: Monitoring under the Fuel Quality Directive. February, 2022. ETC CM Eionet. Accessed April, 2023.*

*6. IEA – Biofuels report, September 2022. Biofuels – Analysis - IEA accessed April, 2023,*

## The three ages of biofuels

Biofuels are derived from biological materials such as plants or organic waste. They can be classified into three generations, based on the feedstock and the production technology used:

- ***First-generation biofuels:*** Produced from food crops rich in sugar, starch, or oil, these biofuels are the most widely adopted and commercially viable. Their production has raised concerns about competition with food production, and about land-use change and deforestation. The two main fuels are biodiesel and bioethanol.
  - ***Biodiesel*** is produced mainly from vegetable oils including soybean, rapeseed/canola, or palm oil. Biodiesel can be used in diesel engines without any modification and is often blended with petroleum diesel.
  - ***Bioethanol*** is an alcohol fuel produced by fermenting sugars such as sugarcane, corn, and sugar beets. Bioethanol can be blended with gasoline or used as a standalone fuel in flex-fuel vehicles such as those in Brazil.

- ***Second-generation biofuels*** use feedstocks which are more abundant and have less impact on food production, but the production processes are more complex. They use non-edible crops and biomass waste such as food waste, agricultural waste and forestry waste.

- ***Third generation biofuels*** use feedstocks with no food value, high yields with virtually no land requirement, and relatively low-cost production requirements. The main feedstock explored to date is algae, but production is not yet commercially viable. Many companies have exited this technology, and it is in a very early stage.

The second-generation biofuels utilizing animal fats, used cooking oil, and non-edible vegetable oils to produce renewable diesel (RD) or Biojet (for blending with jet fuel) is currently one of the most exciting areas for decarbonization of transportation. The production of these ***second-generation biofuels helps to decarbonize two of the most challenging segments in transportation, heavy-road transport and aviation.***

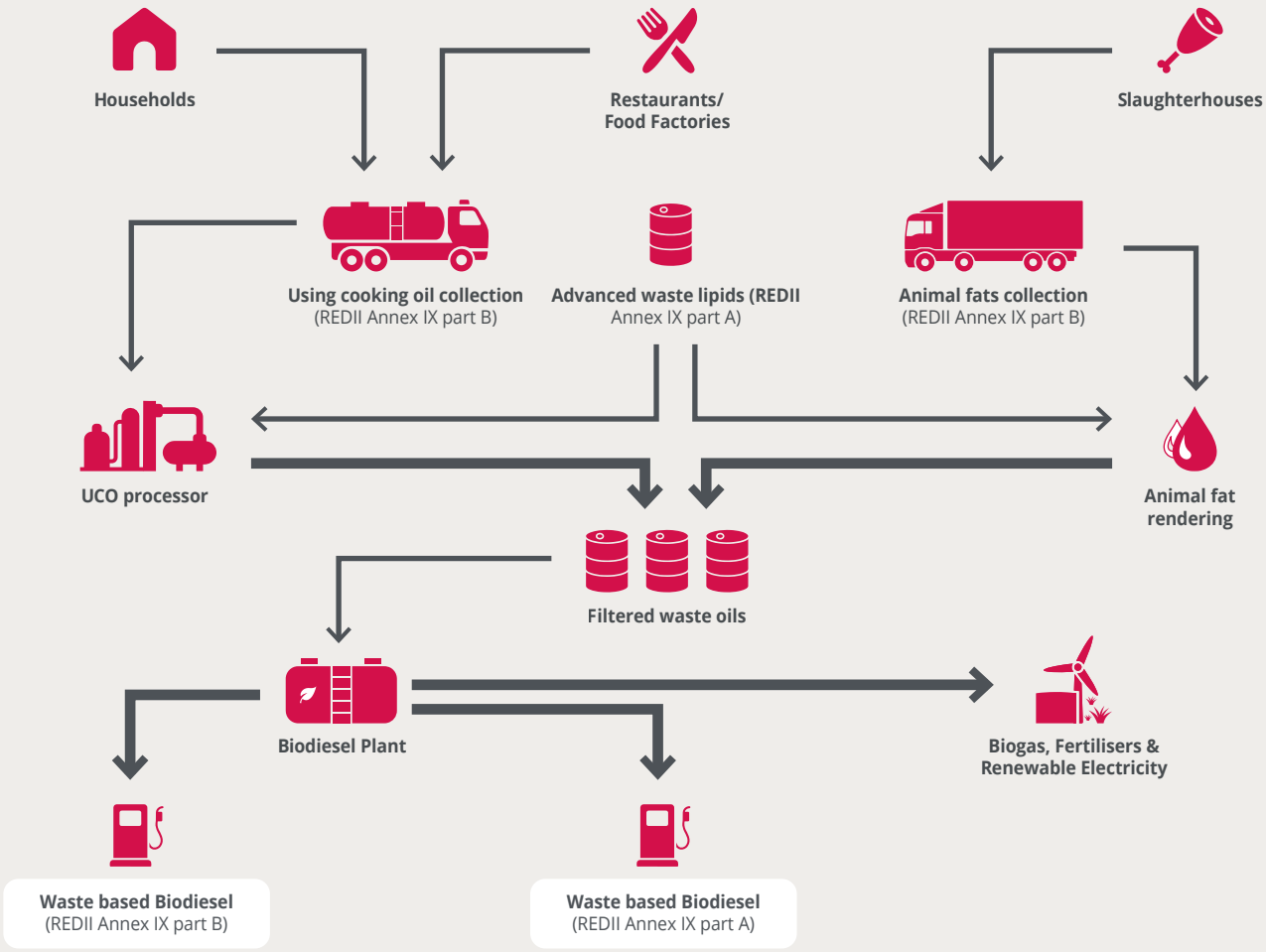
Second-generation renewable diesel provides several advantages over first-generation biodiesel, particularly because it can be used almost interchangeably with diesel. Depending on the feedstock, this carbon intensity reduction can be significant.

For example, Diamond Green Diesel, a US renewable diesel producer, estimates an 80% reduction in carbon intensity compared to fossil fuel diesel when utilizing used cooking oil, and a 68% reduction when using animal fats.[7]

*7. Valero, Basics-of-refining-and-renewable-diesel-2023.pdf (q4cdn.com) , page 24. Accessed April, 2023.*


Diamond Green Diesel estimates an 80% reduction in carbon intensity compared to fossil fuel diesel when utilizing used cooking oil.

## Figure 2: Feedstock Carbon Intensity



## The food vs fuel debate

The availability of feedstocks has become a limiting factor for new entrants. The growth of renewable diesel (RD) in the US, driven both by regulations in California and by Federal tax credits, has been significant, with capacity expanding by 44% in 2022.[8] Yet many producers are unable to access waste feedstocks or lack the capacity to treat them, resulting in the use of vegetable oils such as soybean or palm oil.

Renewable is not enough. First generation biofuels have been directly linked to deforestation, land-use change, and negative impacts on local communities in certain regions, which has pushed some regulators such as those in Europe to limit their use. The US and Europe are planning to strengthen feedstock requirements to reduce competition with food production for arable land.

These concerns are valid and require monitoring. Happily, according to the IEA, in 70% of renewable diesel in 2021 was derived from wastes and residues. It can be done, so incentives must continue to develop growth in this area while capping the production of first-generation biofuels. In advanced economic, production of first-generation biofuels is already on the decline. Globally, however, the decline has been offset by growth in emerging economies.

At Candriam, as responsible investors, we have a strict policy on palm oil requiring that companies in which we invest demonstrate that their sourcing is SR sustainable,) and with a clear policy in place against deforestation.[9]

*8. IEA – Biofuels report Biofuels – Analysis - IEA, accessed April, 2023.*
*9. The Candriam Exclusion Policy is available on our website at SRI Publications_Candriam Policies_Candriam Exclusion Policy*

## To space and beyond?

The renewable diesel (RD) market is dominated by two players: Finnish refiner Neste and US-based Diamond Green Diesel', Several large oil companies are also present in the market -- typically entering by converting refineries. Chevron entered the RD category in 2022 through its $3 billion acquisition of US-based Renewable Energy Group. Incumbents such as Neste and Diamond Green Diesel usually have better access to waste residues for feedstock, while new players and oil companies find themselves more reliant on vegetable oils.

'Biojet', or Sustainable Aviation Fuel (SAF), is seen as the future growth area for the industry. Aviation currently contributes 2.5%[10] of global CO2 emissions, and aviation emissions continue to grow. Electric and hydrogen solutions are still far in the future for aviation, leaving SAF as the only viable medium-term solution – unless, of course, we can reduce air traffic. SAF has been certified under the ASTM standards for global aviation, for up to 50% of the aviation fuel blend. The SAF market is still in an early stage. In 2021, the US produced only 19 million gallons of SAF, which pales in comparison to the 20 billion gallon annual consumption of US airlines before the pandemic. This fuel consumption is forecast to double by 2050. Thankfully, the incentives in place are driving exponential growth in the SAF market:

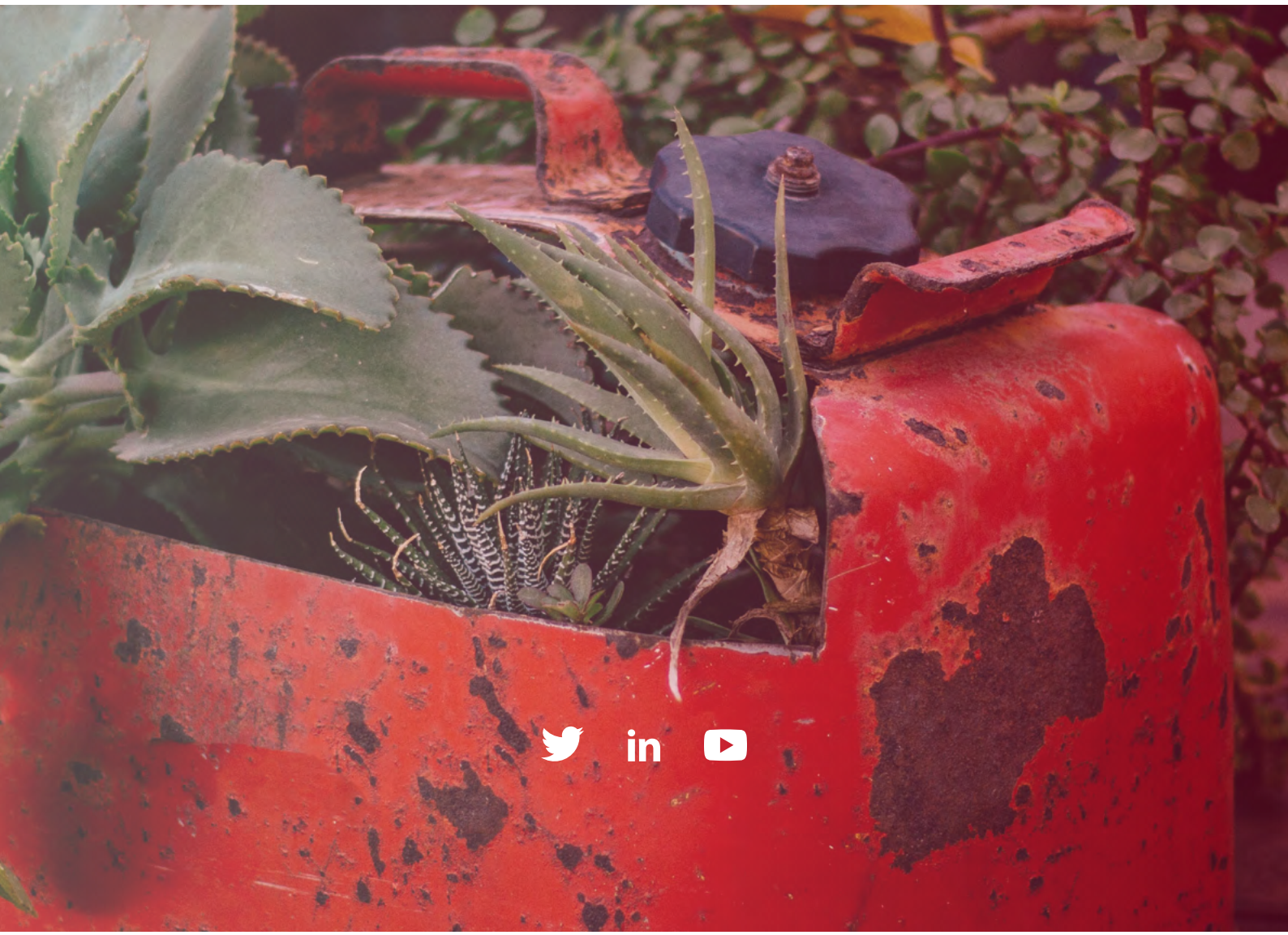
- The Biden administration in the US aims to produce 3 billion gallons of SAF by 2030 and has introduced a tax credit as an incentive.
- In Europe, regulation requires SAF blending to reach 2% by 2025 and 5% by 2030.
- The global airlines industry has agreed on a voluntary plan called CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) to stabilize the industry's CO2 emissions.

SAF is currently two to three times more expensive than traditional jet fuel,[11] but the market opportunity is attracting a number of new entrants. Over the next five years, the supply of SAF is expected to compound at a 54% annual rate, compared to just 19% for renewable diesel.[12]

Beyond environmental concerns, one risk to the expansion of this carbon solution is the volatility of feedstock prices. The second-generation technologies are likely to solve this problem through vertical integration to increase the predictability of access to and prices of feedstocks.

Because of the potential growth of the biofuels market, investors may wish to position part of their portfolio in this market. It is therefore essential to make a precise assessment of these players, the technologies they use, the environmental benefits associated their biofuel technologies and their potential growth, beforehand. At Candriam, because we've been considering "green energy" in our sustainable portfolios for over 25 years, we have the knowledge and vision to help you make the transition to biofuels. Although we recommend that you peddle your bicycle or take the train, the next time you fly, consider blending some SAF, Neste already serves 50 airlines. you fly, consider blending some SAF, Neste already serves 50 airlines.

*10. Global Carbon Budget 2019, aviation only, accessed April, 2023. Carbon Budget (globalcarbonproject.org).*
*11. Boeing CEO warns climate-friendly biofuels will 'never achieve the price of jet fuel' | Financial Times (ft.com)*
*12. BNEF Renewable Fuels Project Tracker, 2023 Global Renewable Fuel Projects Tracker (1.2.1) | BloombergNEF (bnef.com), accessed April, 2023.*





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