A BRAND-NEW ERA IN COMBATTING THE **WORLD'S ENERGY CONSUMPTION**



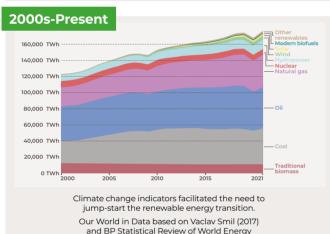
Two centuries of energy consumption, four (finite) sources. Twenty years of new thinking, five new sources...

Until the mid-19th century, traditional biomass – the burning of solid fuels such as wood, crop waste, or charcoal – was the dominant source of energy used across the world. The Industrial Revolution ushered in a new era of energy consumption, where traditional biomass, coal, oil and natural gas were the main sources of energy until the end of the 20th century.

The 21st century saw another shift in the energy sector with the adaption of nuclear and other renewable energy sources as main sources of energy.

1800s-2000s 160,000 TWI

Since the 21st century, Nuclear energy and other Renewables energy sources started to play an important role in energy consumption Our World in Data based on Vaclav Smil (2017)

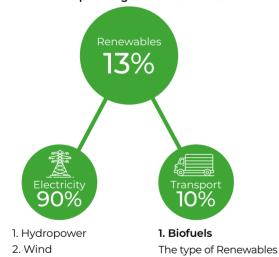






Dual challenges of reducing CO₂ emissions and Climate Change

For our supply to meet demand, we need planning and new actions...



2 Types of Biofuels



Gas

3. Solar

4. Geothermal

· Biogas CH₄

· Biohydrogen Syngas

that use Biomass to

produce energy

Liquid

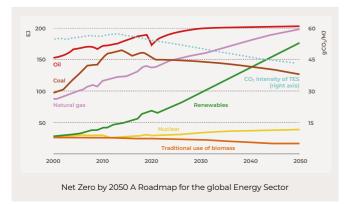
· Bioethanol · Biodiesel

· Hydrogenated Vegetable Oil

HVO (=Renewable Diesel) Biobutanol

Net zero by 2050 Ambitious targets to combat a critical issue

Renewables will be the third Energy Source by 2050.

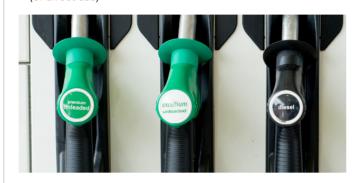


Liquid biofuels – Driving decarbonisation of the transport sector

Two major technology transitions:

1. Shifts towards Electric Mobility

2. Increase **Liquid Biofuels** blending ratios in normal fuels



Bioethanol E10 10% blending with petrol gasoline Biodiesel **B7** 7% blending with diesel

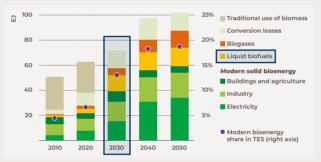
Road transport: Biofuels replicates the blending process with normal diesel: the goal is to reach a 15% blending share in oil products by 2030.

*Which reduces oil needs by around 4.5 million barrels of oil equivalent per day

Aviation transport: In 2030, around 15% of total fuel consumption in aviation is Sustainable Aviation Fuel (SAF). *By 2050 biojet kerosene meets 45% of total fuel consumption in aviation

Liquid biofuels -The third largest source by 2030

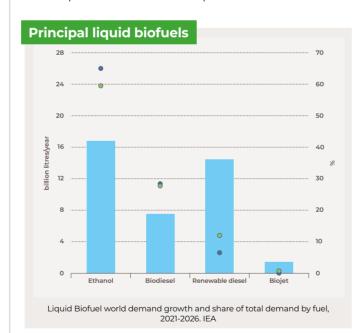
NZE predicts a supply acceleration by x4.



Total Bioenergy supply in the NZE scenario

Asia surpasses total European biofuel production in the forecast period thanks to strong domestic policies and growing liquid fuel demand.

The United States and Brazil remain the largest centres for both Liquid Biofuel demand and production.



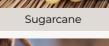
Demand for liquid fuel biofuels' feedstocks:

Addressing the controversies and finding solutions

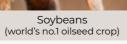
Biofuels feedstock oils are mainly produced from conventional crops such as:











Rapeseed 1. Directly compete with arable land that can be used for food

production, potentially increasing the food price market. 2. **Edible oils** make-up around **70**% of the feedstock used in the world's Biofuels production.

Ethics and Moral Controversies

Competition with food market? Increasing food price?

Second generation and advanced feedstocks - production that won't impact food supply.

1. Wastes and residues: UCO (Used Cooking Oil) & Animal Fats 2. Food based biomasses that have already fulfilled their food

purpose & necessities 3. Crops grown on marginal lands not suitable for food

Liquid Biofuels acceleration x4

Advanced **Feedstocks**

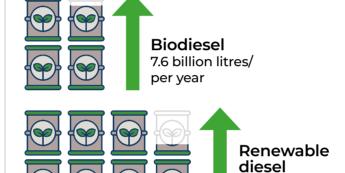
Advanced biofuels – a champion of the new era

Biofuels produced from Advanced Feedstocks will make up 45% of Biofuels consumed in 2030 in the Net Zero Scenarios.

Advanced biofuels – champion of the new era

Huge opportunity to expand research & materials, harnessing our existing knowledge and products for rapid progression.

Biofuel demand growth by fuel, 2021-2026



- 1. Together they'll make up the main Biofuels produced in the world
- 2. Both have similar or same (HVO) physical properties as normal Diesel

Our current diesel matrix

Ready to go simply by changing the metrics of our existing products:

- CRMU CFGO Cold Filter Cloud Point
- CRMU CPGO Cloud Point • CRMU DEGO **Density**
- CRMU DEGO Flash Point

HVO BS EN 15940:2016





14.5 billion litres/



Biodiesel Europe: EN 14214:2012 EEUU: ASTM D6751 12



Our priorities: Saturation / unsaturation

For CRMs of Physical properties with strong correlation:

- Degree of Saturation/Unsaturation
- Mother feedstock

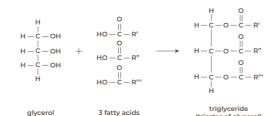
Final fuel physical properties will depend mainly on the raw material/mother feedstock used.

Biodiesel & HVO

Feedstocks / UCO and waste Animal Fats ...are mainly composed of: Triglycerides

Triglycerides

Contain 3 Fatty Acids 1 Glycerol



Fatty Acids "contains" the Degree of Saturation/Unsaturation.

Fatty Acids

- More than 20 types of Linear and Curved / Flexible Fatty Acids
- 1 Oil or Animal Fat can contain 4 to 9 different Fatty Acids Physical properties of the fuel will **DIRECTLY** depend on:
- Fatty Acids profile of UCO (Used Cooking Oil) & wastes of **Animal Fats**
- Biofuel physical properties are solely controlled by the mother feedstock

Fatty Acids: Degree of Saturation/Unsaturation

Saturated (Linear) Unsaturated (Flexible)

Analysing the effect on high-concern specifications:

Cold flow properties Fuel behaviour under

cold environments



Cetane Number



Unsaturated

Fatty Acids



Fatty Acids





Feedstock UCO Soybean, **UCO** Rapeseed

UCO Palm Oil, Animal Fats wastes



New era of Advanced Biofuels:





New line of Biofuels CRMs for LGC Industrials including our Paragon Scientific product lines



Helping us all to achieve net zero by 2050



