Bio4A
Advanced Sustainable Biofuels for Aviation

SAF and Low-ILUC risk biomass feedstock: the BIO4A project

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EUBCE June 8th,2023

RE·CORD eni SKYNRG etaflorence renewableenergies CENER Camelina Company | España Politecnico di Torino

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 789562.

Call: LCE-20-2016-2017 Topic: Aviation Biofuels
Project title: Advanced sustainable BIOfuels for Aviation (BIO4A)

PROJECT CONCEPT

Accelerate the deployment of Aviation Biofuels, enabling commercial production. Supporting the accomplishment of pre-commercial plant(s) for advanced biofuels for aviation based on sustainable biomass feedstock.

PROJECT OBJECTIVES

1) To bring HEFA to full commercial scale in new plant using residual lipids (Used Cooking Oil - UCO);
2) To investigate alternative supply of sustainable feedstocks recovering EU MED marginal land for drought resistant crop production;
3) To test the entire chain and logistic at industrial scale, and assess environmental performances.
4) Positive GHG and energy balance expected

Highlights (technological/non-technological):

- New Aviation Biofuel plant producing HEFA
- Production and test of HEFA in commercial flights in non-segregated mode
- R&D Work on marginal land in Spain and Italy recovered by biochar/compost addition producing non-food sustainable lipids
- Dedicated Dissemination, Communication and Exploitation action

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Industrial Activities M1 – M52

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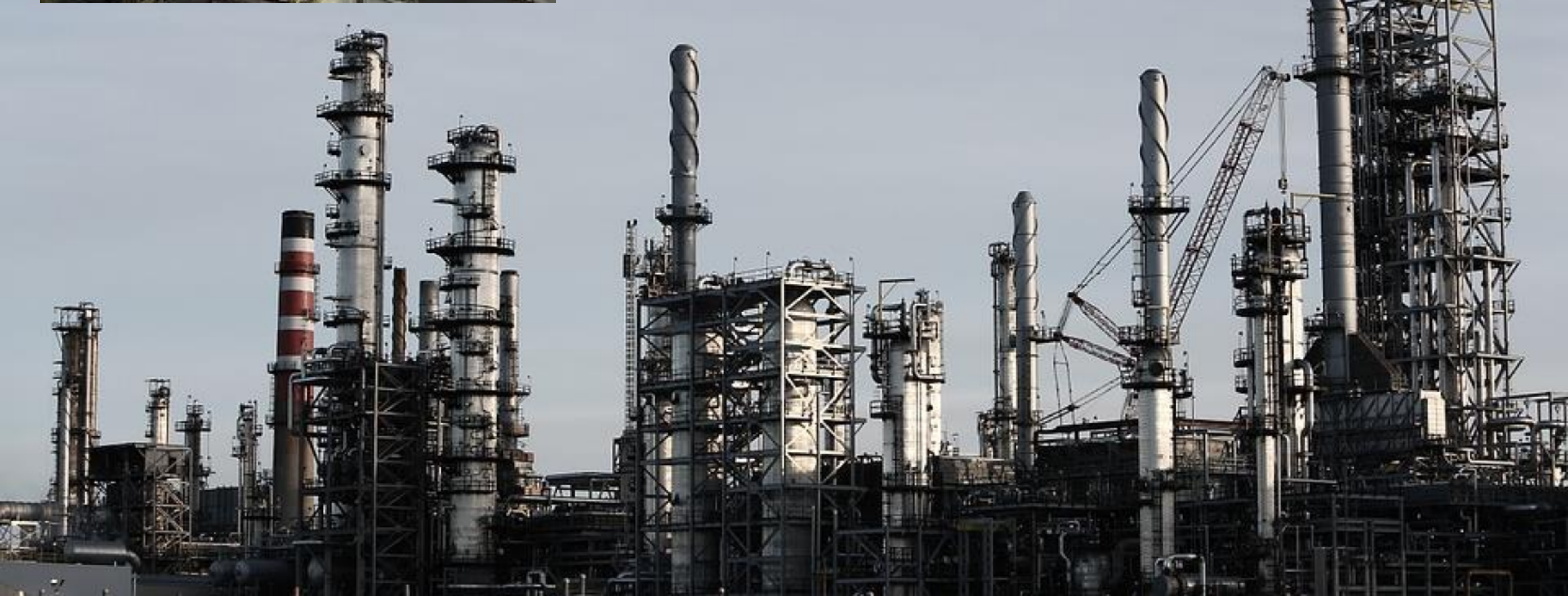
Industrial Activities M1 – M52

GELA Biorefinery



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Industrial Activities M1 - M59

Current Status

- ✓ 1000 metric tons of HEFA produced by ENI in Gela from residual lipids
- ✓ HEFA is ASTM compliant (KPI attained)
- ✓ Internalized distillation step from HVO to HEFA by ENI in Livorno: revamping of unused, former distillation column
- ✓ Value chain demonstrated
- ✓ Flight plan delivered (SKYNRG)
- ✓ HEFA blended in Amsterdam
- ✓ Fuel delivered to Schipol Airport
- ✓ Offtake by KLM for commercial flights

Milestone achieved!

Inc

eni

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Pagina 1 di 2

Data: 12-04-2023
Rapporto di Prova
Boll_01_2023_044511
Data di campionamento: 08-04-2023
Serbatoio: 111
Sample: 201515223

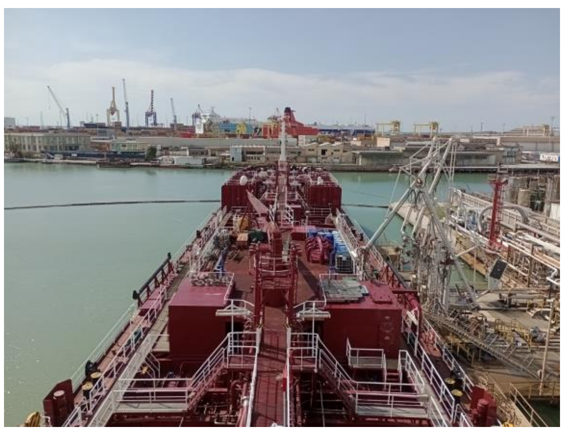
Prodotto

ENI BIOJET

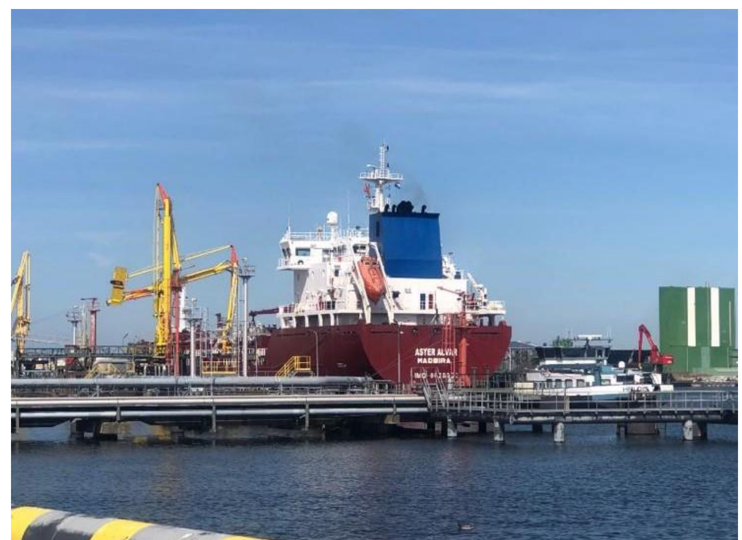
Codice prodotto: 281

Analisi	Nota	U. di M.	limiti	Metodo IP	Metodo ASTM	Risultato
Appearance						
Aspetto	(1)	---	Passa		ASTM D4176	Passa

EVOS Terminal Amsterdam



Charging operations on Aster Alvar vessel in Livorno



Discharging operations of Aster Alvar in Amsterdam 02/06/2023

R&D Activities M1 - M52

Current Status

- ✓ Year 3 agronomic field trials in Spain on marginal land completed, biochar protocol identified (CCE, RE-CORD)
- ✓ Year 1 agronomic field trials (larger scale) in Italy completed, biochar protocol confirmed (RE-CORD)
- ✓ Lysimeters Experiment Completed (RE-CORD)
- ✓ Larger climatic chamber for lysimeters experiments completed (RE-CORD)

- ✓ Assessment of potential for drought-resistant oil crop in marginal land of Southern Europe and abroad completed (JRC)
- ✓ Business case completed (SKYNRG)
- ✓ Waste feedstock market analysis completed (SKYNRG)
- ✓ Report on Market Dynamics delivered (SKYNRG)
- ✓ Environmental Assessment completed
- ✓ New drought-resistant Camelina variety patented (CCE)
- ✓ IPR Strategy identified (RE-CORD, CCE, ALL)
- ✓ Environmental and Social LCA to be published in June 2023

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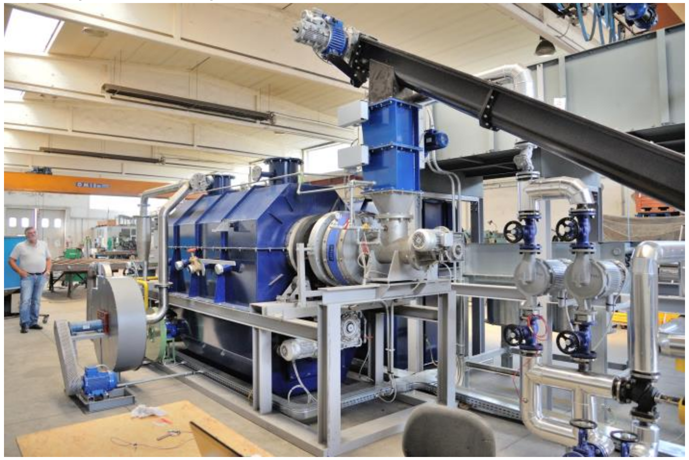
R&D Activities M1 - M52

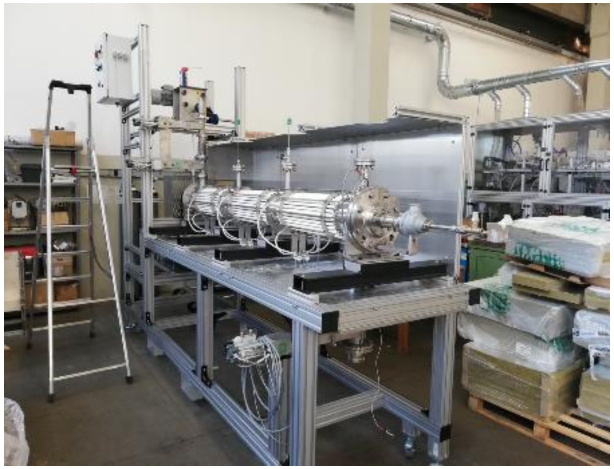
R&D Activities on biochar production plant from woodchips and agroresidues

- ✓ Design and test activities on Moving bed pyrolysis reactor model adaptation and innovative concept prototype (SPYRO)
- ✓ Mechanical works on Fixed bed carbonization unit.
- ✓ Moving bed carbonization unit installed, in operation since 2020.

R&D Activities performed on UCO pre-treatment to contribute to and enhance the long-term supply of this feedstock

- ✓ Hydrolysis and non-catalytic thermochemical conversion tests performed for alternative FFA production pathway





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EU REDII-Implementing Regulation

27.6.2022 EN Official Journal of the European Union L 168/1

COMMISSION IMPLEMENTING REGULATION (EU) 2022/996 of 14 June 2022
on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land- use change-risk criteria

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources [1], and in particular Article 30(8) thereof,

Whereas:

(1) Directive (EU) 2018/2001 expands the role of voluntary schemes to include the certification of the compliance of biomass fuels with sustainability and greenhouse gas (GHG) emissions saving criteria and the compliance of renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels with the respective GHG emissions saving criteria. Furthermore, the voluntary schemes can be used to certify biofuels, bioliquids and biomass fuels with low indirect land-use change-risk.

(2) In order to establish whether biofuels, bioliquids, biomass fuels, renewable gaseous and liquid transport fuels of non-biological origin and recycled carbon fuels comply with the requirements of Directive (EU) 2018/2001, the correct and harmonised functioning of voluntary schemes is essential. Harmonised rules should therefore be established, to apply across the certification system, bringing about the necessary legal certainty on the rules applicable to economic operators and voluntary schemes.

(3) With a view to minimising the administrative burden, the implementing rules should be proportionate and limited to what is required to ensure that compliance with the sustainability and GHG emissions saving criteria and other requirements is verified in an adequate and harmonised manner that minimises the risk of fraud to the greatest extent possible. The implementing rules should therefore not be considered as a comprehensive standard but rather as minimum requirements. The voluntary schemes may accordingly complement these rules as appropriate.

(4) Economic operators may decide at any time to participate in a different voluntary scheme. However, in order to prevent an economic operator that has failed an audit under one scheme from immediately applying for certification under another scheme, all schemes receiving an application from an economic operator should require that operator to supply information about whether it failed an audit in the previous 5 years. This should also apply to situations where the economic operator has a new legal personality but remains the same in substance, so that minor or purely formal changes, for instance, in the governance structure or the scope of activities, do not exempt the new economic operator from such a rule.

[1] OJ L 328, 21.12.2018, p. 82.

REDII Esca factor – Carbon Stock calculation

ANNEX V

METHODOLOGY FOR DETERMINING THE EMISSION SAVINGS FROM SOIL CARBON ACCUMULATION VIA IMPROVED AGRICULTURAL MANAGEMENT

Economic operators seeking to claim emission savings from soil carbon accumulation via improved agricultural management (**e_{sca}**) in terms of g CO_2eq/MJ should use the following formula to calculate their actual values:

$$e_{sca} = (CS_A - CS_R) \times 3{,}664 \times 10^6 \times \frac{1}{n} \times \frac{1}{P} - e_f$$

Where:

CS_R	is the mass of soil carbon stock per unit area associated with the reference crop management practice in Mg of C per ha.
CS_A	is the mass of soil estimated carbon stock per unit area associated with the actual crop management practices after at least 10 years of application in Mg of C per ha.
3,664	is the quotient obtained by dividing the molecular weight of CO_2 (44,010 g/mol) by the molecular weight of carbon (12,011 g/mol) in g CO_{2eq}/g C.
n	is the period (in years) of the cultivation of the crop considered.
P	is the productivity of the crop (measured as MJ biofuel or bioliquid energy per ha per year).
ef	emissions from the increased fertilisers or herbicide use

Biochar is included as an improved agricultural practice for Soil Carbon Accumulation

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EU on Carbon and Sust.Fuels: REDII - IA

(a) greenhouse gas emissions from the production and use of biofuels shall be calculated as:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr},$$

where

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II

(Non-legislative acts)

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Improved agriculture management practices, accepted for the purpose of achieving emission savings from soil carbon accumulation, include shifting to reduced or zero-tillage, improved crop/rotation, the use of cover crops, including crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation, digestate, biochar, etc.).

The calculation of the actual values of CS_R and CS_A shall be based on measurements of soil carbon stocks. The measurement of CS_R shall be carried out at farm level before the management practice changes in order to establish a baseline, and then the CS_A shall be measured at regular intervals no later than 5 years apart.

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The entire area for which the soil carbon stocks are calculated shall have a similar climate and soil type as well as similar management history in terms of tillage and carbon input to soil. If the improved management practices are only applied to part of the farm, the GHG emissions savings can only be claimed for the area covered by them. If different improved management practices are applied on a single farm, a claim of GHG emission savings shall be calculated and claimed individually for each e_{sca} practice.

To ensure reduced year-to-year fluctuations in the measured soil carbon stocks and to reduce associated errors, fields that have the same soil and climate characteristics, similar management history in terms of tillage and carbon input to soil and that will be subject to the same improved management practice may be grouped, including those fields belonging to different farmers.

After the first measurement of the baseline, the increase in soil carbon can be estimated based on representative experiments or soil models, before a second measurement of the increase in carbon stock is made. From the second measurement onwards, the measurements shall constitute the ultimate basis for determining the actual values of the increase in soil carbon stock.

However, after the second measurement, modelling to enable economic operators to estimate the annual increase in soil carbon stocks may only be permitted until the next measurement if the models used have been calibrated, based on the real values measured. Economic operators shall be obliged to use only models that have been validated by voluntary schemes. Voluntary schemes shall be obliged to inform the economic operators and the certification bodies, performing audits on their behalf, about the models that they have validated for such use.

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(¹) OJ L 328, 21.12.2018, p. 82.

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where

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To claim emissions savings from soil carbon accumulation via agricultural management (e_{sca}), measurements of soil carbon stocks shall be performed by certified laboratories and samples shall be retained for a period of at least 5 years for auditing purposes.

A long-term commitment by the farmer or economic operator to continue applying the improved management practice for a minimum of 10 years shall be required by voluntary schemes in order for GHG emission savings to be taken into account. Such commitment may be implemented as a 5-years renewable commitment.

In addition, a continuous minimum period of 3 years for the application of the improved management practice shall be required before a claim can be made.

The maximum possible total value of the annual claim of emission savings from soil carbon accumulation due to improved agricultural management (e_{sca}) shall be capped to 45 g CO_2eq/MJ biofuel or bioliquid for the entire period of application of the Esca practices, if biochar is used as organic soil improver alone or in combination with other eligible e_{sca} practices. In all other cases, the cap referred to above shall be 25 g CO_2eq/MJ biofuel or bioliquid for the entire period of application of the e_{sca} practices.

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EU on Carbon and Sust.Fuels: REDII - IA

Examples of essential soil management practices to promote soil carbon sequestration (given the absence of residues) and promote soil quality

Requirement	Soil quality parameter
At least a 3-crop rotation, including legumes or green manure in the cropping system, taking into account the agronomic crop succession requirements specific to each crops grown and climatic conditions. A multi-species cover crop between cash crops counts as one.	Promoting soil fertility, soil carbon, limiting soil erosion, soil biodiversity and promoting pathogen control
Sowing of cover/catch/intermediary crops using a locally appropriate species mixture with at least one legume. Crop management practices should ensure minimum soil cover to avoid bare soil in periods that are most sensitive.	Promoting soil fertility, soil carbon retention, avoiding soil erosion, soil biodiversity
Prevent soil compaction (frequency and timing of field operations should be planned to avoid traffic on wet soil; tillage operation should be avoided or greatly reduced on wet soils; controlled traffic planning can be used).	Retention of soil structure, avoiding soil erosion, retaining soil biodiversity
No burning of arable stubble except where the authority has granted an exemption for plant health reasons.	Soil carbon retention, resource efficiency
On acidic soils where liming is applied, where soils are degraded and where acidification impacts crop productivity.	Improved soil structure, soil biodiversity, soil carbon
Reduce tillage/no tillage – Erosion control – addition of organic amendments (biochar, compost, manure, crop residues) – use of cover crops, rewetting Revegetation: planting (species change, protection with straw mulch) – landscape features – agroforestry	Increase soil organic carbon

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EU on Carbon and Sust.Fuels: REDII - IA

Table 1

Examples of monitoring practices for soil quality and carbon mitigation impacts

Monitoring approach	Method of verification/demonstration
Risk assessment	Identifying areas with high risk of soil quality decline helps prevent these risks and focus on areas with the greatest impact.
Soil organic matter analysis	Consistent sampling of soil organic matter improves monitoring so that this matter can be maintained or improved.
Soil organic carbon analysis	Soil organic carbon is seen as a good marker for wider soil quality.
Soil conditioning index sampling	A positive value indicates the system is expected to have increasing soil organic matter.
Soil erosion assessment	Ensures that erosion is below a tolerable level, e.g. USDA Agricultural Research Service 't' levels.
Nutrient management plan	A plan outlining nutrient strategy (focusing mostly on N, P, K) and fertiliser regimes can prevent nutrient imbalances.
Regular soil pH analysis	Monitoring pH helps identify imbalances in pH.

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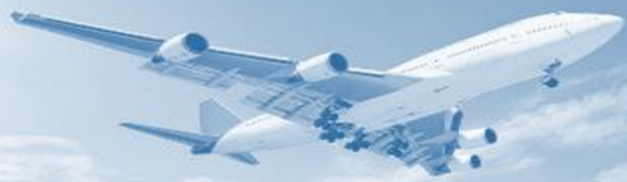
BIO4A - Lessons learnt from industrial component

Production of HEFA is possible, but challenging

- **Current SAF supply** remains low—less than **0.05 %** of total EU aviation fuel use *(EASA: EU Envir.Report 2022, EASA)*
- SAF volumes in the EU will increase very fast
  - ✓ ***SAF**: 2% 2025, 5-6 % 2030, 32-37% 2040, 38-54% 2045, 63-85% 3050, of which*
  - ✓ ***Synthetic fuels** (eFuels): 0.04% 2025, 0.7-2% 2030, 5% 2035, 8-13% 2040, 11-27% 2045, 28-50% 2050*
- HEFA Technology is ready, **capacity expanded** through BIO4A
- Key issue is to develop **supply chains** for sustainable lipids compliant with REDII (III)
- **New value chains** (e.g. lignocellulosic) must quickly rump-up to full industrial scale
- **Book & Claim**?
- **<u>In-sector measures not sufficient in any scenario</u>**

Advanced Sustainable Biofuels for Aviation



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