Conference
7-8 November 2024

Key messages, Summary, and Analysis of the Questionnaire

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Author: Kyriakos Maniatis, PhD, Independent Consultant

For: Centre for Renewable Energy Sources and Saving (CRES)

Address: Grote Baan 66
1650 Beersel,
Belgium

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Preamble

This report concerns the conference "Sustainable Aviation Fuels – Time for take-off", that took place in Athens on 7-8 November 2024. The conference was organised by CRES and the agenda was prepared by Mrs Myrsini Christou and Mr Kyriakos Maniatis.

The agenda of the conference is given in Annex 1. There were about 120 participants registered. The list of participants is given in Annex 2.

The conference addressed policy, regulatory, and technology for SAF and it was a timely event fulfilling the expectation not only to inform the key stakeholders but also to provide the impetus to accelerate coordinated actions in view of preparing the Greek strategy in addressing the ReFuelEU-Aviation regulation obligations.

To meet these targets, innovative value biomass supply chains will have to be established to provide the resources needed in a reliable manner giving confidence to potential investors. In addition, reliable biomass conversion SAF technologies are needed while several value chains are still under innovative development. In sort, it is a complex *airspace*.

CRES organised this conference under the auspices and patronage of the Ministry of Environment and Energy of Greece aiming to inform the stakeholders on the necessary actions that must be undertaken to place the Greek aviation industry on an accelerated *FlightPath* to achieve the aims and objectives of the ReFuelEU aviation Initiative for Greece.

The objectives of this report are:

- to summarise the key messages from the conference on issues related to sustainable aviation fuels (SAF) policies and technologies as these were presented during the conference, and,
- to analyse a questionnaire (see Annex 3) that was drafted by the author of this report and was sent to all speakers and participants of the conference.

18 of the speakers and 10 participants (see Annex 4) submitted the completed questionnaire.

In the discussion below several slides have been copied from the presentations. All presentations can be accessed at the conference site:
http://cres.gr/cres/saf/index.html.

The key messages in the Executive Summary are mainly takn by the technology description and analysis of the Questionnaire.

Executive Summary

The Executive Summary is based on the Status of the SAF Technologies as these were presented in the conference and on the analysis of the Questionnaire that was submitted by 18 speakers and 10 participants. Since both the status of the technologies and the analysis of the questionnaire are discussed in the report, the Executive Summary is drafted on the basis of key messages.

Key Messages on the Status of the SAF Technologies

The hydrotreating of lipids for HEFA SAF is the only technology and value chain that is commercial with several technology providers and plants in the EU and worldwide; the TRL is >9.

Ethanol to jet and gasification with Fischer Tropsch value chains follow in the TRL level of 7 to 9. Pyrolysis oil upgrading or coprocessing is in the range of 7 to 8.

While breakthroughs can be expected for ethanol to jet and gasification with Fischer Tropsch in the next year or two, the e-SAF is expected to reach commercialisation in about 8-15 years.

Several Horizon Europe projects were presented by Greek institutions in the TRL level of <6. These technologies need quite some further work on all aspects of the value chains and technologies before they can reach a TRL level of >8 with several additional years of improvements and optimization before they can be considered commercial.

Key Messages from the analysis of the Questionnaire

In general, the stakeholders believe that the REFuel EU Aviation Regulation and its targets have a positive effect on the deployment of SAF in the EU, however, the measures and policies are not sufficient to ensure that the targets will be met. Overall, there is belief that the EU SAF ecosystem has not reached sufficient maturity yet.

Additional measures such as loan guarantees and more stable long term policies are needed.

The stakeholders have limited experience with the Innovation Fund (IF). Applying to the IF seems to be a complex and expensive process that may exclude small companies.

Some stakeholders prefer using national funds and credits which is perceived to be simpler and straightforward process with high probability of successsful outcome.

There is urgent need for dedicated financial support for First-of-a-kind-Plants (FOAK) as well as additional support measures such as loan guarantees.

There is general agreement amongst the stakeholders that much more needs to be done concerning feedstock availability. Ensuring the farmer gets additional income; long term feedstock offtake agreements and a stable policy framework concerning biomass sustainability are key messages from the stakeholders.

Furthermore, there is need to create a fair playing level field with US ethanol-to-jet production which is based mostly on food-based crops.

It is a repeating theme that better designed financial support schemes for First-of-a-Kind plants (FOAK) and CAPEX support are needed to support the deployment of SAF technologies.

There is general agreement that the role of oil companies is pivotal and they can help deploy new technologies. However, the stakeholders are of the opinion that the oil companies have not fully supported SAF yet, and much more must be done.

Airlines can play a critical role in facilitating SAF market uptake by entering into off-take agreements. They can also support start-ups by investing in equity and help projects reach FID through offtake contracts.

Horizon Europe provides good support for research up to a TRL of 5-6 but above that level more targeted financial support is necessary to facilitate demonstration and technology commercialisation.

There is general understanding that a lot of work still must be done before Greece will have a good and stable ecosystem to push through the needed legislation to facilitate SAF deployment.

From the responses it appears that the Greek oil companies must improve their communications with the stakeholders on their efforts to develop SAF in Greece.

The stakeholders expect Aegean to implement a voluntary market and sign long term offtake agreements with developers while at the same time creating further awareness on SAF to key market actors and directly discussing with the Government on the needs to develop the appropriate framework.

The stakeholders are of the opinion that there are significant quantities of unexploited biomass in Greece, and it is necessary to provide strong incentives for its collection via supply chains and offtake agreements.

Appropriate feedstocks in Greece are primarily herbaceous agricultural residues (e.g. straw) and energy crops.

Exploitation of marginal and abandoned lands as well as sustainable cropping systems can significantly improve biomass availability in Greece.

CRES has significant experience on sustainable cropping systems and on growing biomass in marginal lands.

It became apparent during the conference that there is sufficient collaboration between the research community and the oil companies in Greece, however, this collaboration needs to be further strengthened.

The ICARUS project is a good example where different stakeholders and the society are represented.

Presentations on SAF Policies

International Aviation Developments

Preti Jain presented the IATA policy targets. IATA estimates that Sustainable Aviation Fuel (SAF) could contribute around 65% of the reduction in emissions needed by aviation to reach net zero CO2 emissions by 2050. This will require a massive increase in production to meet demand. The largest acceleration is expected in the 2030s as policy support becomes global, SAF becomes competitive with fossil kerosene, and credible offsets become scarcer. Achieving net zero CO2 emissions by 2050 will require a combination of maximum elimination of emissions at the source, offsetting and carbon capture technologies.

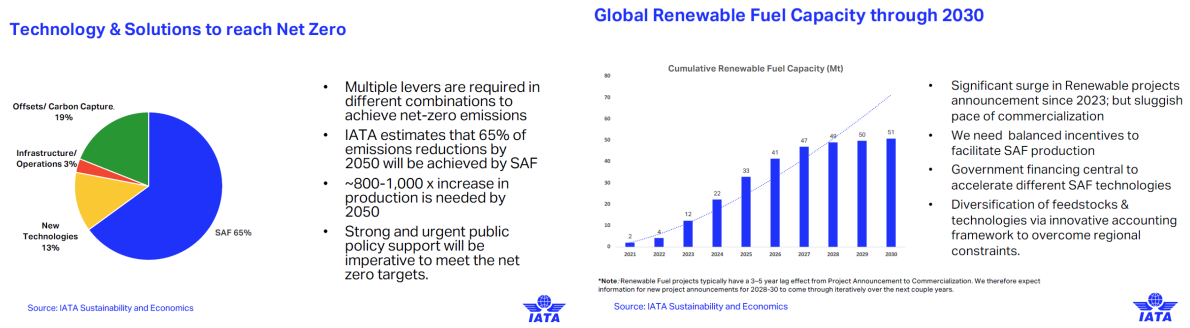

Figure 1: Preeti Jain's - IATA key messages

Matteo Prussi of the Politecnico di Torino presented the positions of ICAO. He presented that the liquid alternative fuels are recognised as an effective short-medium term mean for decarbonising international aviation and that the penetration of disruptive technologies (e.g. electrification) is expected to occur at a different pace than in other sectors (e.g. road). CORSIA recognizes two different eligible fuels; *SAF: Sustainable Aviation Fuels* are defined as renewable or waste-derived aviation fuels that meets the CORSIA Sustainability Criteria and *LCAF: Lower Carbon Aviation Fuels* are defined as a fossil-based aviation fuel that meets the CORSIA Sustainability Criteria. He also presented the key elements for SAF uptake prioritizing Sustainable feedstock availability and Production Capacity.

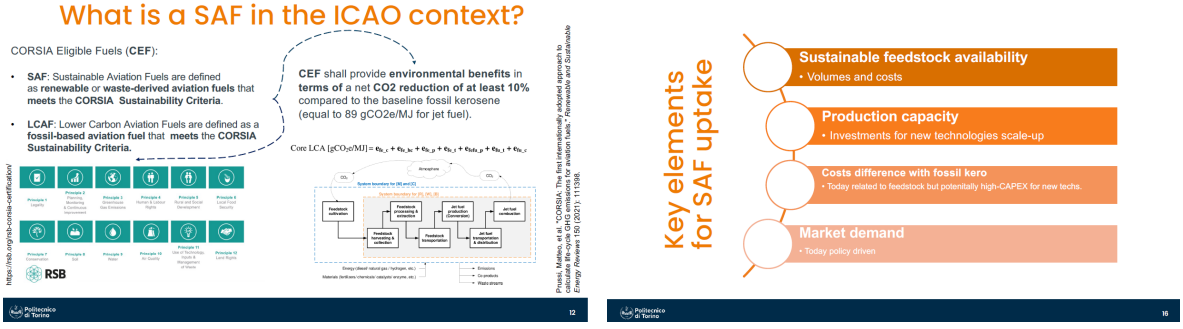

Figure 2: Matteo Prussi's key messages from ICAO.

Kees Kwant of the Dutch Ministry of Climate and Green Growth presented the Integrated Biorefineries Mission (IBM) of Mission Innovation. The goal of IBM is to develop and demonstrate innovative solutions to accelerate the commercialisation of integrated biorefineries with a target of replacing 10% of fossil based fuels chemicals and materials with biobased alternatives by 2030. IBM has partnered with Horizon Europe on the new call for development of smart concepts of integrated energy-driven bio-refineries. Kwant informed the conference that the IBM is based on 3 pillars: Supporting Research & Development, Accelerating Pilots & Demonstrations and Improving Policy and Market Conditions. IBM is working to set Common System Boundaries and alignment of the Life Cycle Assessment.

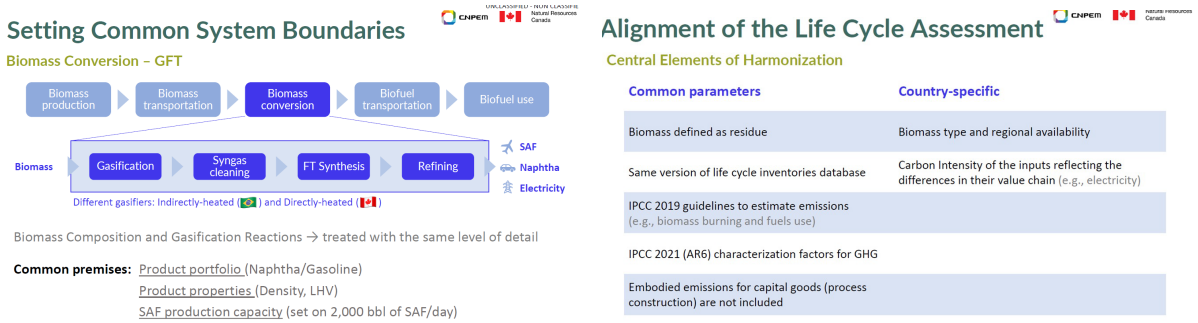

Figure 3: Kees Kwant's key messages from the Integrated Biorefineries Mission

Kyriakos Maniatis**,** independent consultant, presented a SAF policy analysis he undertook for the ICARUS project. He commented that the ReFuelEU Aviation mandate was the only policy that targeted eSAF too and that nuclear power was also included for providing the eSAF electricity. Furthermore, he observed that the EU policy has the most stringent GHG requirements, which makes it more difficult to meet the targets compared with other nations' policies. He also reported that recent developments in China to promote a SAF ecosystem may lead to a limited supply of HEFA SAF and scarcity of used cooking oil used for HVO production in the EU and beyond.

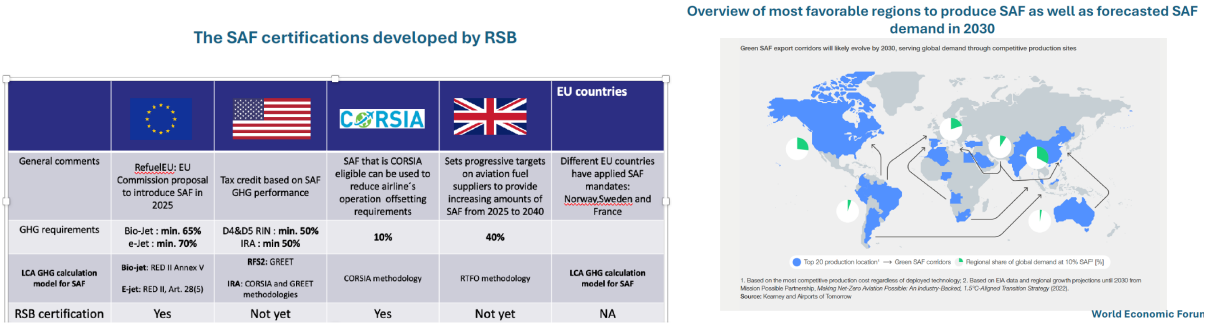

Figure 4: Kyriakos Maniatis' key messages from the ICARUS policy analysis

European Policy Developments

Ewa Oney of the Directorate General of Mobility & Transport presented the policy framework for the ReFuelEU Aviation Regulation that requires the collaboration of all parties in the supply chain, in particular aviation fuel suppliers, EU airports and airlines. The ReFuelEU

Aviation aims to achieve 2% share SAF in EU airports from 2025 to be increased to 70% from 2050 and 1.2 share of synthetic SAF in EU airports from 2030 to be increased to 35% from 2050. The sustainability of the aviation fuels will be critical while the Regulation allows the use of synthetic low carbon aviation fuels and hydrogen for aviation.

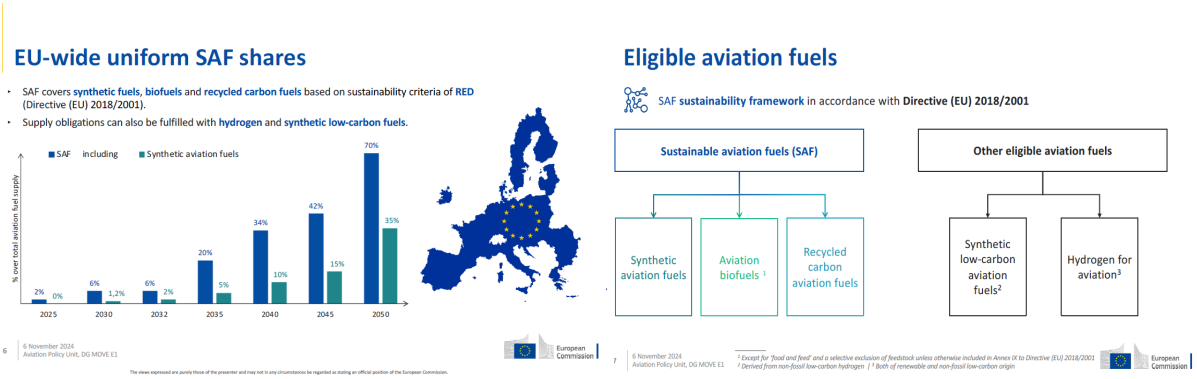

Figure 5: Ewa Oney's key messages from the ReFuelEU Aviation Regulation

Eric van den Heuvel's of studio Gear Up presentation focused on the need for an integrated, multi-sectoral policy support for increased investments on renewable fuels. He said that since the 2030 RED III renewable energy volumes are much larger than the 2030 volumes equivalence in FuelEUMaritime and ReFuelEU Aviation there is need for more attention to road transport since it can provide the "volume" to establish a scale-up learning curve and economies of scale as a first step that could later be applied to the aviation and maritime sectors. For SAF he drew the attention to the possible synergies that could facilitate deployment.

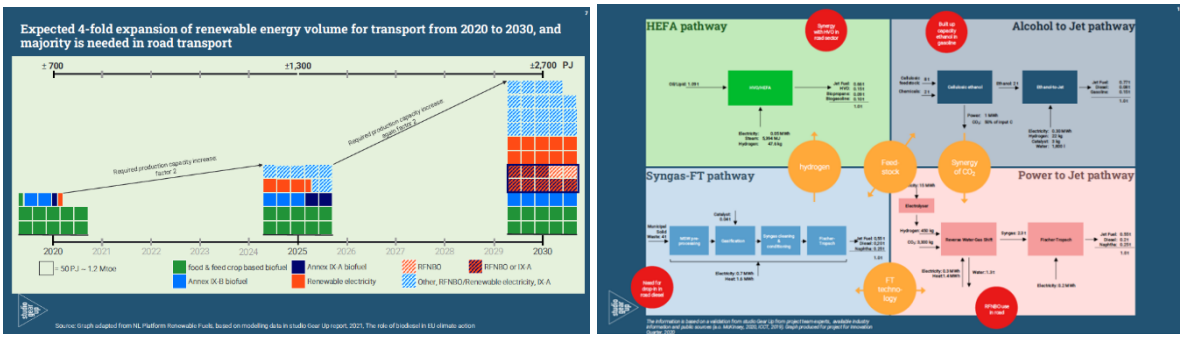

Figure 6: Key massages by Eric van den Heuvel

Sergi Alegre of Airport Regions Council, presentation focused on the need to accelerate the production of SAF as at present there are doubts whether the capacity to reach the goals for 2035 and later can be achieved. He also pointed out that while there have been several announcements for SAF projects from South to North of the EU, there are no announcements on SAF production plants in the East and Southeast of the EU. He also stressed that the EU airports are assisting the other stakeholders to develop an EU market for SAF.

Figure 7: Key messages by Sergi Alegre

Considerations on National SAF Policy

Aristotelis Aivaliotis, General Secretary of Energy and Minerals, spoke on the efforts undertaken by the Ministry of Environment and Energy to support the Greek stakeholders in the aviation sector to implement the ReFuelEU Aviation Regulation. He emphasised that the Minister would enter into discussions with the European Commission to identify the most appropriate financial support measures for the Greek industry stakeholders to initiate the production of SAF in Greece.

Christos Tsitouras**,** Governor D/G Hellenic Civil Aviation Authority, (HCAA) informed the participants that a SAF working Group has been established in Greece by the Athens International Airport with all key aviation stakeholders in Greece. The HCAA has established dedicated websites on the ReFuelEU Aviation, the EASA sustainability Portal, and participates in the ICAO ACT–SAF & LTAG Goals platforms. He pointed out that Greece has particular geographical characteristics with many small regional airports. The government and HCAA shall ensure affordable clean energy supply for aircraft operations for the long-term sustainability of relevant operations and ensure air connectivity of Greek islands with the mainland.

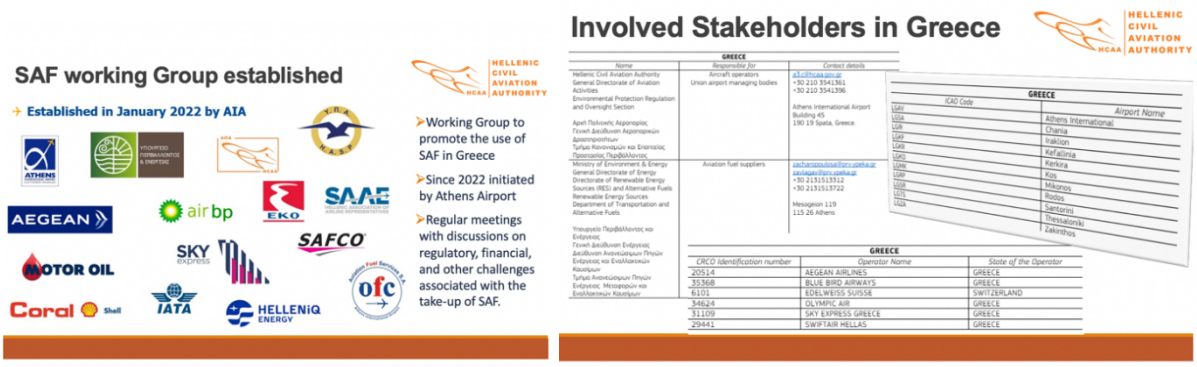

Figure 8: Key messages by Christos Tsitouras

Practical SAF experiences in Greece

Spyros Svoronos, of Motor Oil presented the alternative fuels and circular economy strategies that include advanced biofuels and e-fuels. He informed the participants that the SAF blending obligations to be implemented in Greece translate to 120kta and 400kta SAF national blending in 2030 and 2035 respectively. He further presented the available SAF eligible pathways and feedstocks pointing out that HEFA is the most widely used value chain for SAF with several energy majors investing in it (TOTAL, ENI, CEPSA, NESTE etc.). He provided some information concerning the Corinth refinery where co-processing capability for bio-feedstock intake test had been completed and necessary adjustments had been taken place preparing the refinery for 2025.

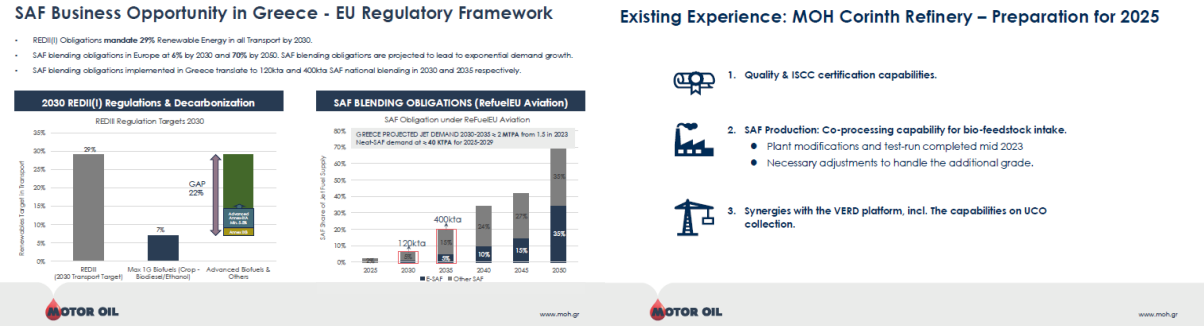

Figure 9: Key messages by Spyros Svoronos

Michalis Papazoglou, of HELLENiQ ENERGY (HELPE) presented their vision with various actions taking place such as investing in a new HEFA unit for SAF production capable of processing several feedstocks (treated or untreated) under ANNEX IXB & IXA (REDIII) to cover aviation fuel demand forecasts at least up to 2030. Furthermore, HELPE plans for a new e-Jet unit that will cover all additional demand in synthetic aviation fuels, made from renewable hydrogen and captured carbon. He also presented the decarbonisation projects of HELPE in their refineries in Greece. The major refinery projects of HELPE include among other a UCO co-processing for biodiesel production; a new unit for SAF production and the Green Hub North (green H2 & NH3).

Figure 10: Key messages by Michalis Papazoglou

Panagiotis Argianas**,** of EKO ABEE HELLENiQ ENERGY, informed the participants on the SAF experience in Greece by EKO which was the first SAF supplier in Greece. He presented several of the initial results and discussed some of the key supply chain considerations. He also highlighted the considerations related to the chain of custody model and the mass balance system. He concluded his presentation raising some clarifications that are needed by the ReFuelEU Aviation Regulation to facilitate the market deployment of SAF.

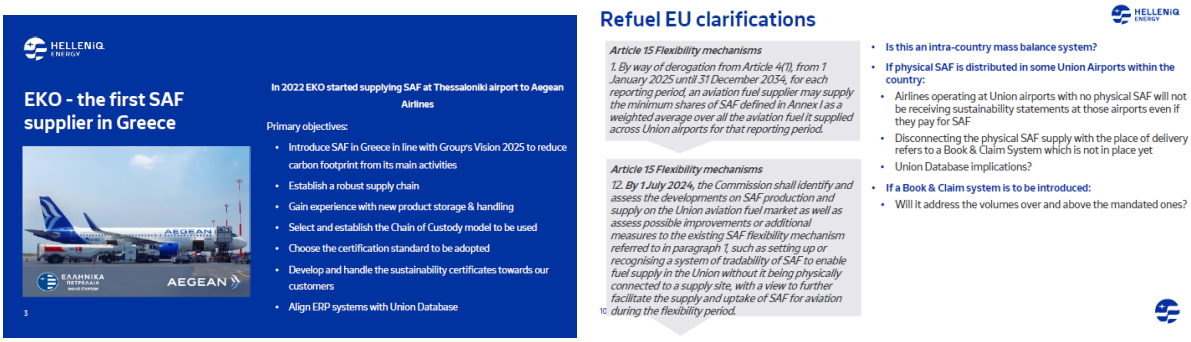

Figure 11: Key messages by Panagiotis Argianas

Giorgos Govatzidakis, of AEGEAN presented the experience of the airline with SAF and some of the critical considerations airline companies must address concerning aircraft technology as well as fuel and propulsion options for commercial aviation post 2020. Specifically for Greece there are two key issues: energy production and geography. For the former he mentioned that there is great potential for a "Nucleus" SAF production hub in Greece, combined with expansion of renewable energy sources (hydrogen, CCS etc.) while for the later the airline must consider issues such as insularity, seasonality and airport location challenges and infrastructure. However, he pointed out the travel experience must be protected.

Figure 12: Key messages by Giorgos Govatzidakis

SAF Global Market situation

Jim Spaeth**,** of the US Department of Energy presented the US SAF Grand Challenge which is a government-wide initiative. The objective of this Challenge is to expand the domestic production of SAF to meet 100% of domestic demand for aviation fuel. It has a short-term goal of 3 billion gallons by 2030 corresponding to 20% CO_2 reduction and a long-term goal of 35 billion gallons by 2050. The SAF Grand Challenge is a multi-Agency collaboration with the Departments of Energy, Agriculture and Transport working together to meet the targets. The US is developing a SAF Roadmap Implementation Framework to be published soon.

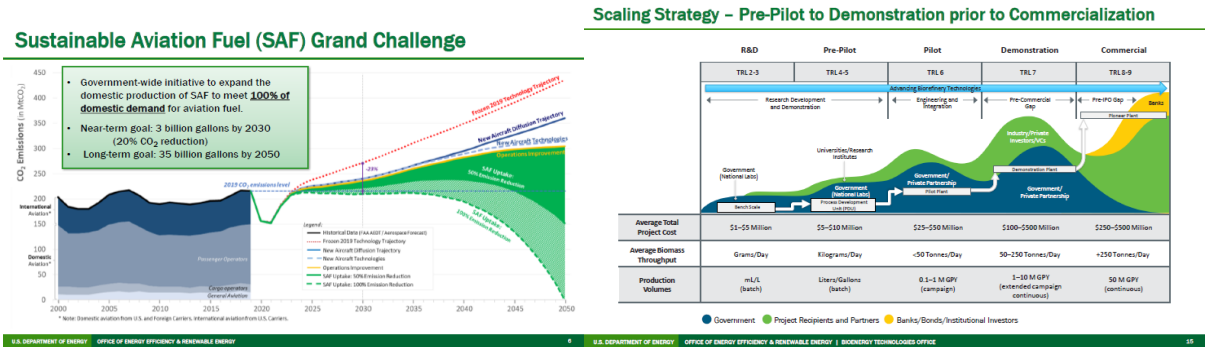

Figure 13: Jim Spaeth's key messages on SAF implementation policies in the US

Eline van Berlo, of SkyNRG presented the 2024 SAF Market Outlook. She informed the participants that there has been a snowball effect for SAF mandates, and these are developing across the world rapidly. At present the mandates and announced targets add up to 16 million ton of SAF demand by 2030. However, these targets are still significantly lower for what is needed to reach the net-zero pathway. She noted that it is not possible to reach the 2035 SAF blending targets in ReFuelEU only with HEFA SAF. To bridge the gap the next generation of SAF from waste streams and hydrogen is needed; however, this is not easy to be achieved and just a mandate is not sufficient.

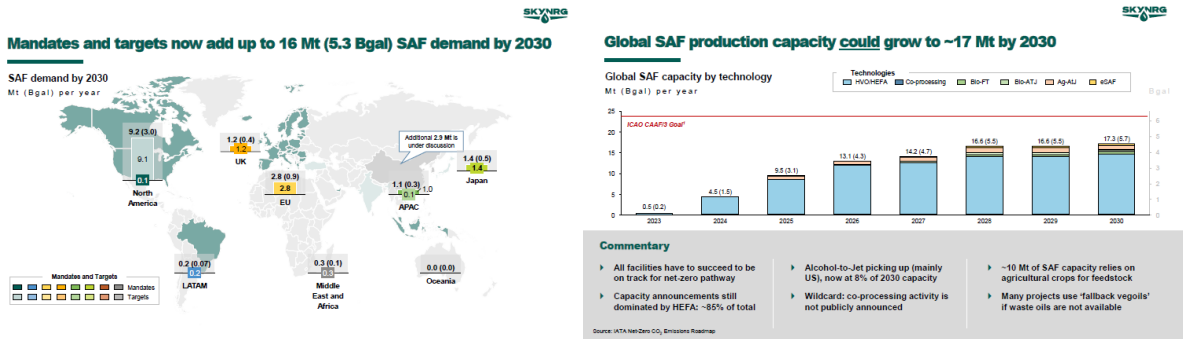

Figure 14: Eline van Berlo's key messages from the SkyNRC 2024 SAF Market Outlook

Blanca de Ulibarri**,** of the Round Table on Sustainable Biomaterials (RSB) presentation focused on sustainability and certification issues for SAF. She commented on the need to have a holistic approach encompassing all aspects of SAF such as managerial, environmental and

social. RSB has developed certification schemes for EU RED directive, CORSIA and Global covering fuels and advanced products. She stressed that certification could play a key role in ensuring that the production of renewable fuels is sustainable and leads to GHG emissions reduction.

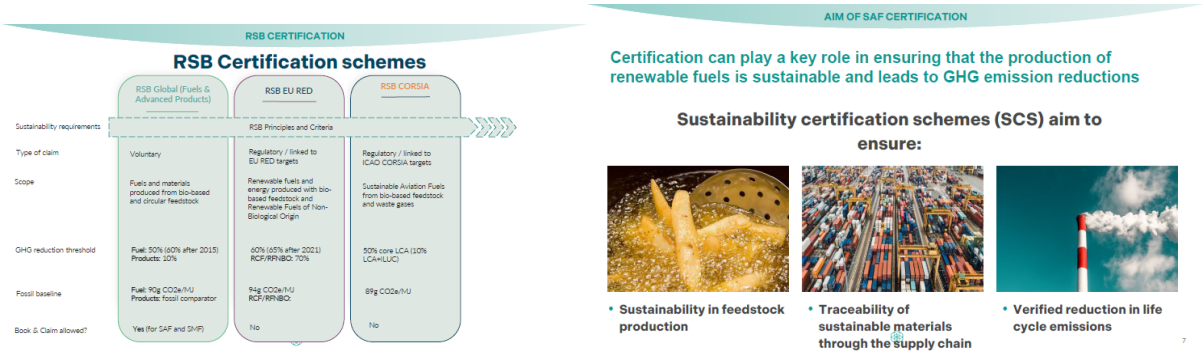

Figure 15: Blanca de Ulibarri's key messages related to SAF certification

Eleni Liakakou, of Ricardo presented the recently established EU SAF Clearing House (SAF-CH). The SAF-CH expedites the ASTM D4054 fuel evaluation process lowering burden on OEMs and accelerating SAF producers. It is a knowledge centre providing information, data and stakeholder connections to the SAF stakeholders. It aims to remove as many barriers as possible to support the EU & International deployment of SAFs, and the approval of new SAF pathways using the ASTM D4054 evaluation process. It is a one-stop-shop for fuel testing and facilitates the coordination of the several EU actors. Furthermore, it prepares SAF producers for sustainability assessment & certification from recognised bodies.

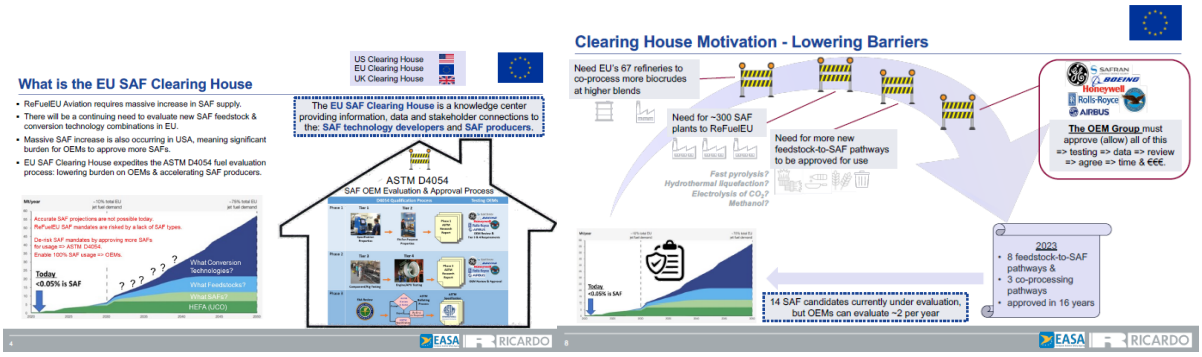

Figure 16: Eleni Liakakou's key messages related to the EU SAF Clearing House

Presentations on Resources and Technology Status

Maria Georgiadou of the Directorate General for Research and Innovation presented the various actions by DG RTD concerning advanced biofuels with emphasis on SAF. She also presented the EU funding programmes that facilitate the development of technologies from the inception to the commercialization stage. She commented that under the Horizon Europe (HE) programme about 80 M€ have been allocated to bring SAF technologies to TRL 7 and about 130 M€ to bring SAF technologies to TRL 5. Several SAF technologies have been supported by HE. She also presented the various EU partnerships.

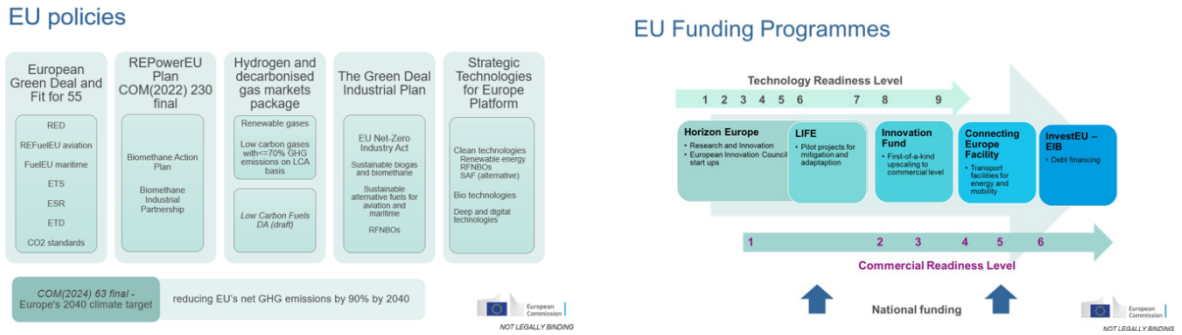

Figure 17: Maria Georgiadou's key messages related to EU research actions

SAF commercial technologies

Ralph-Uwe Dietrich of the German Aerospace Center presented a technoeconomic assessment for large scale SAF production in the EU based on the Techno-Economic Process Evaluation Tool (TEPET). He commented that decarbonization of aviation is technically feasible, but economically challenging. Large scale SAF production using biomass gasification, water electrolysis, FT technology, are all industrial proven processes. However, to move forward and especially for e-SAF; massive rollout of European renewable energy production is required.

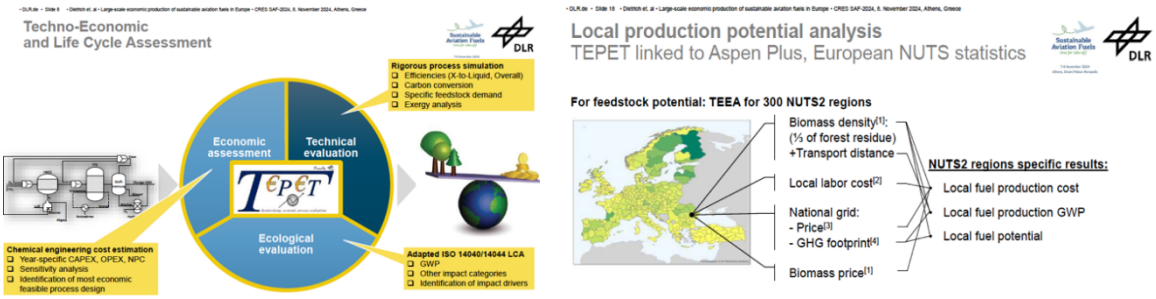

Figure 18: Ralph-Uwe Dietrich's key messages related technoeconomic assessment

Yvon Bernard of AXENS presented the various technologies at AXENS portfolio for SAF. AXENS has experience in several value chains such as oil and fats coprocessing and HEFA-SPK with the VEGAN hydrotreatment; ATJ-SPK with the FUTUROL and JETANOL processes, FT-SPK with the BioTfuel process and then the option to e-SAF with Carbon capture and renewable hydrogen. For all value chains he presented commercial references. He also commented that AXENS can provide a large range of solutions for the decarbonisation of plastics/chemicals and fuels.

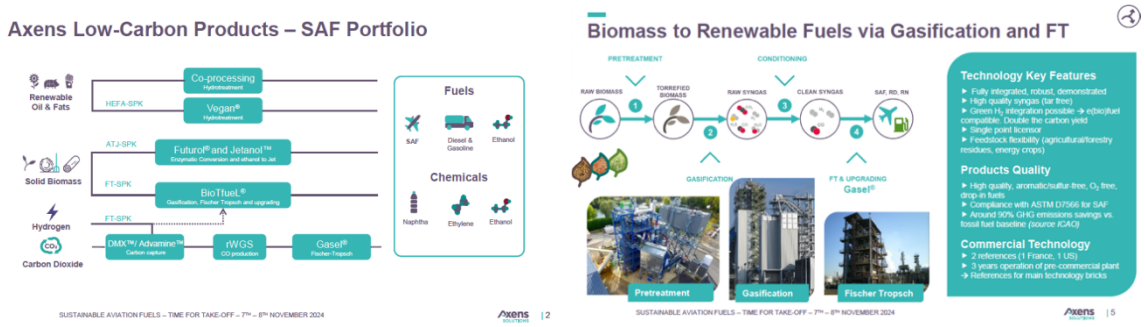

Figure 19: Yvon Bernard's key messages related on AXENS technology

Michael Hecquet of TotalEnergies presented the experiences of the company on SAF. He commented that SAF is the only readily available technology and that liquid fuels are the only solution today and in the near future. However, there is necessity for developing integrated value chains. It is possible to achieve GHG reduction of about 80% compared to fossil kerosene. There is strong policy support with the legislation in the EU and US. From the operational and safety point of view the drop-in solution of SAF requires no major investment by the airlines.

Figure 20: Michael Hecquet's key messages related TotalEnergies experiences with SAF

Ronnie Maddox of Lanzajet presented the technologies developed by the company in combination with LanzaTech. He commented that it takes more than 15 years to bring a technology from the lab to commercialization. LanzaTech has a track record in converting flue gases from industrial emissions to ethanol. The ethanol can be upgraded to SAF using the LanzaJet technology.

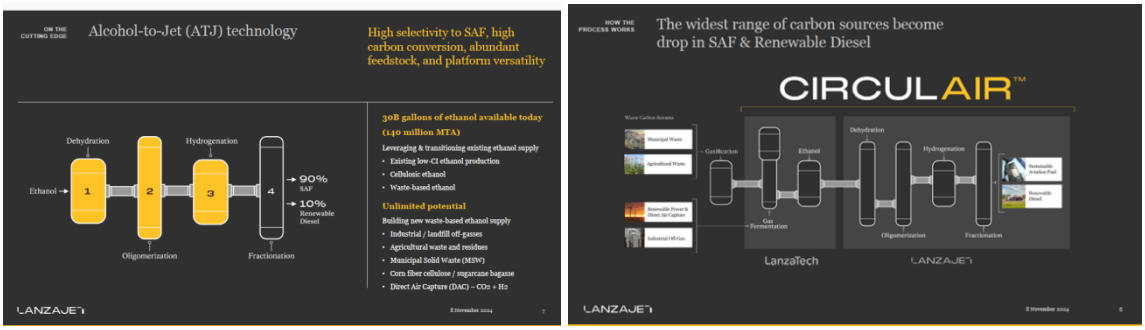

Figure 21: Ronnie Maddox's key messages related to LanzaJet technologies

SAF technologies in large scale demonstration

Bert van de Beld of BTG Bioliquids presented the fast pyrolysis of biomass and the upgrading of the biooil to SAF. The biooil can readily be used in heating applications replacing natural gas and heating fuel. The biooil can also be upgraded to SAF using the DACIA process and this has been proven at pilot scale (TRL 5-6). The upgraded biooil complies with the chemical & physical specification in jet standards. However, due to the high cycloalkane content a fast-track certification is unlikely at present.

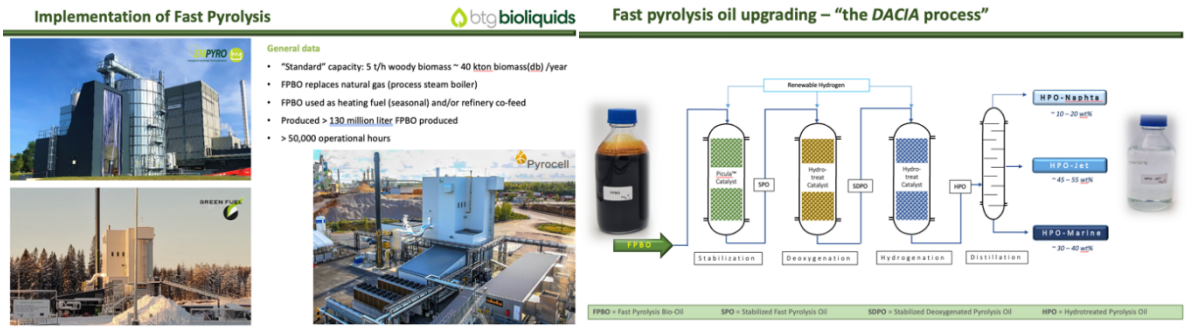

Figure 22: Bert van de Beld's key messages related to upgrading biooil to SAF

Martin Stephan of Global Bioenergies commented that the company has developed a unique bioprocess to synthetize isobutene from natural sources via bacterial fermentation. The process can significantly contribute to cutting CO2 emissions. Global Bioenergies' process is one of the very few SAF technologies in the world certified by ASTM International. Global Bioenergies' fuel can now be blended up to 50% with fossil kerosene in existing airplanes. The company is now working on a combination of its process with green hydrogen based on e-acetic acid as the feedstock.

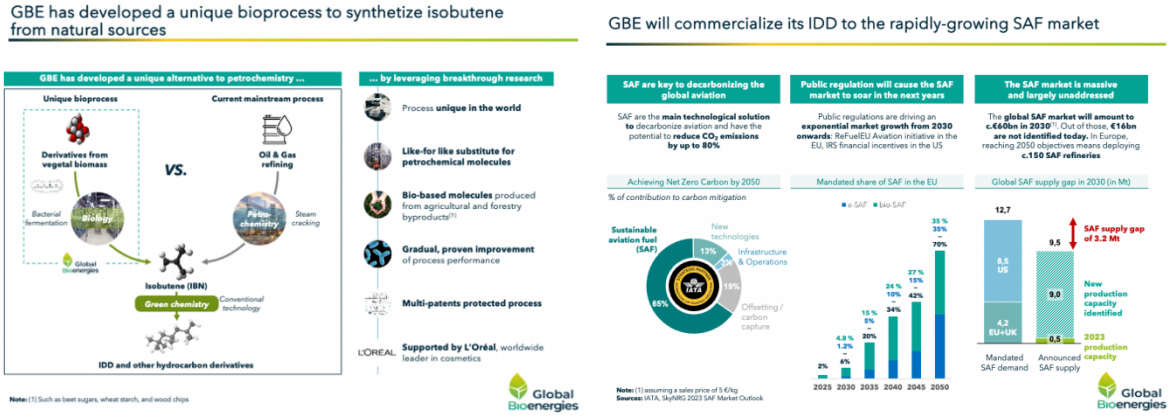

Figure 23: Martin Stephen's key messages related to isobutene upgrading to SAF

SAF technologies in innovative development – International cooperation for sustainable aviation fuels – The ICARUS project as Greek SAF incubator

Myrsini Christou of CRES presented the international cooperation on sustainable aviation fuels based on the experiences of the ICARUS Horizon Europe Project. In addition to the European consortium members there are representatives from Switzerland, Canada, India and Brazil carrying our parallel research while in the Advisory Board of the project there are representatives from the US, IEA, JRC and CONCAWE. This provides for an excellent international cooperation on innovative SAF technologies. She then presented the availability of the various biomass residues and wastes in the EU commenting that agricultural residues are available in sufficient quantities, however the main challenge lies in the competition with other markets and feeds. Overall, the innovations lie in improving the logistics, mainly in the collection of the harvestable material from the fields for agricultural residues. Concerning energy crops the key innovations lie in cropping systems and management.

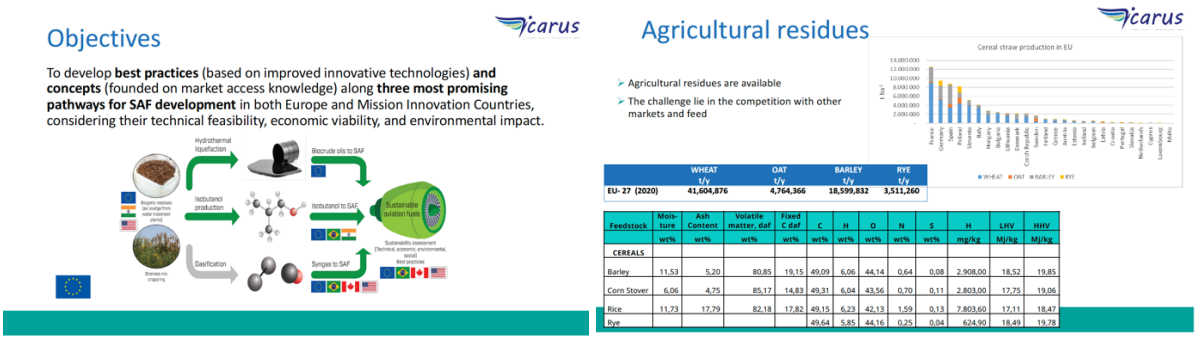

Figure 24: Myrsini Christou's key messages on the international collaboration in ICARUS project

Francisco Girio of LNEG presented the *biocrude oils to SAF* value chain focusing on HEFA and Hydrothermal Liquefaction (HTL) process under evaluation in the ICARUS project. He noted that despite the high potential of SAF, there are still significant barriers the hinder its widespread adoption and market penetration. These relate to cost, which is significantly higher than conventional kerosene, feedstock sustainability to avoid unintended environmental consequences, scale and production capacity of operations that need to be increased significantly to meet demand and adapting the existing infrastructure so that to logistical challenges can be addressed.

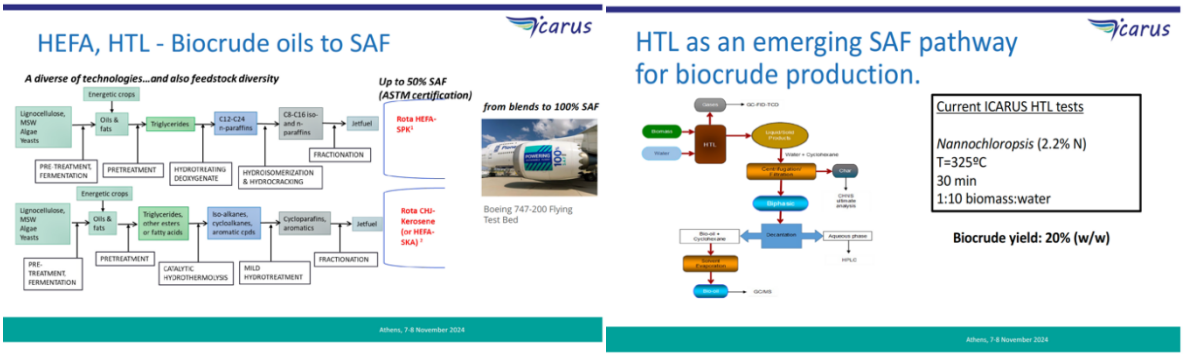

Figure 25: Francisco Girio's messages concerning the biocrude oils to SAF value chain

Ikker Aguirrezabal of EHU/EUS presented the isobutanol pathways to SAF that are being evaluated under the ICARUS project. He commented that pre-extraction decreased the acid requirement and pulp yields from fractionation. Following cellulolytic enzyme engineering four enzymes could be expressed in the 2G yeast strain. He then discussed the conversion of alcohols to SAF and the mechanism of the reaction taking place.

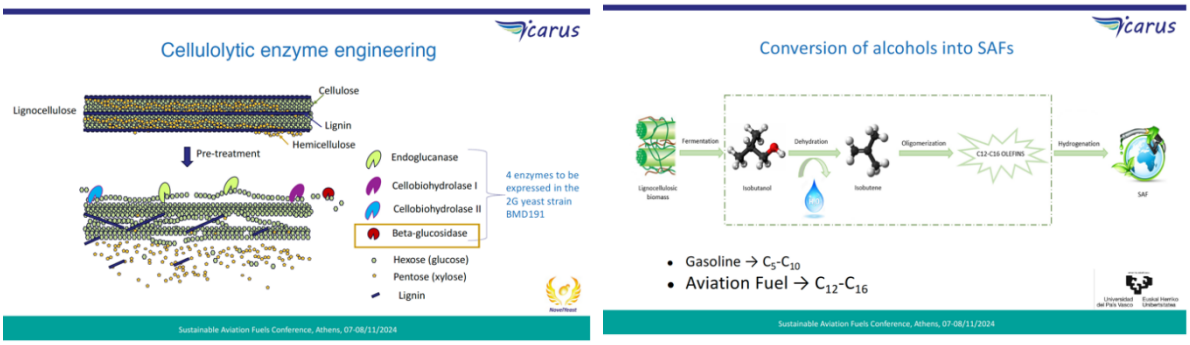

Figure 26: Ikker Aguirrezabal's key points for the isobutanol pathways to SAF

Yadi Ganjkhanlou of TNO presented new routes for converting syngas to SAF studied in the ICARUS project. The main objective for the Syngas-to-SAF routes was to identify catalysts and processing with potential of >45% SAF selectivity. The work concluded that the syngas-to-SAF through olefin synthesis was the most promising/ and flexible route. The highest selectivity was obtained with Na-Ru/SiO2 catalyst. The work will continue concentrating on catalyst stability, duration tests for catalyst lifetime and deactivation.

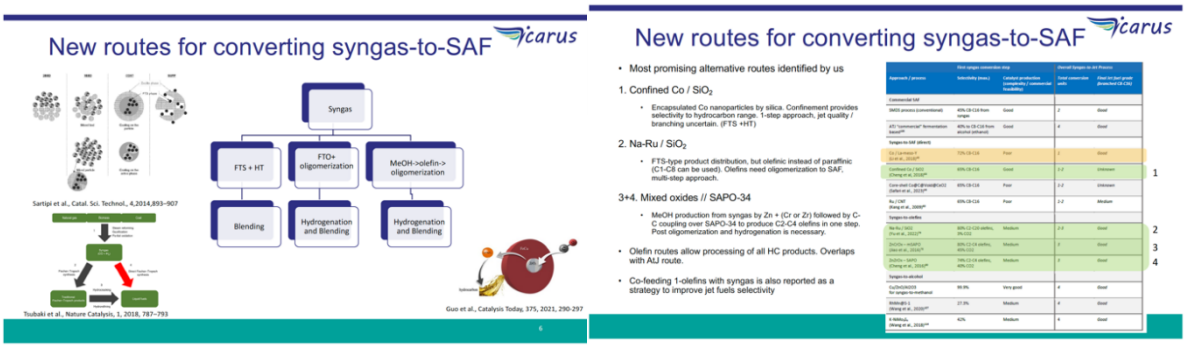

Figure 27: Yadi Ganjkhanlou's key points for converting syngas to SAF

SAF technologies in innovative development

Myrsini Christou of CRES presented the key objectives and structure of the European Alliance for excellent research in sustainable bioenergy (EERA). She reported on the Position Paper which identified key R&I gaps in the fields of bioenergy, biogas, and biofuels for: a) Sustainable production of biomass; b) Thermochemical processes; c) Biochemical processes; d) Stationary biomass; e) Sustainability/techno-socio-economic analyses and f) public acceptance of bioenergy as well as recommendations regarding the way forward. She then presented the key topics in the various platforms of EERA. One of her main conclusions was that public awareness of bioenergy in Europe is low, as compared to other renewables. Some of the main concerns are related to water scarcity and competition with existing food supply and price.

Figure 28: Myrsini's Christou's key messages concerning EEAR Bioenergy

Efthymia Alexopoulou of CRES presented findings from the GOLD project which examines growing selected high-yielding lignocellulosic energy crops on contaminated lands having two-fold purposes: to produce feedstock for clean biofuels with low ILUC risks and to contribute to land decontamination by applying optimized phytoremediation solutions. The project examines various conversion processes with an integrated sustainability assessment.

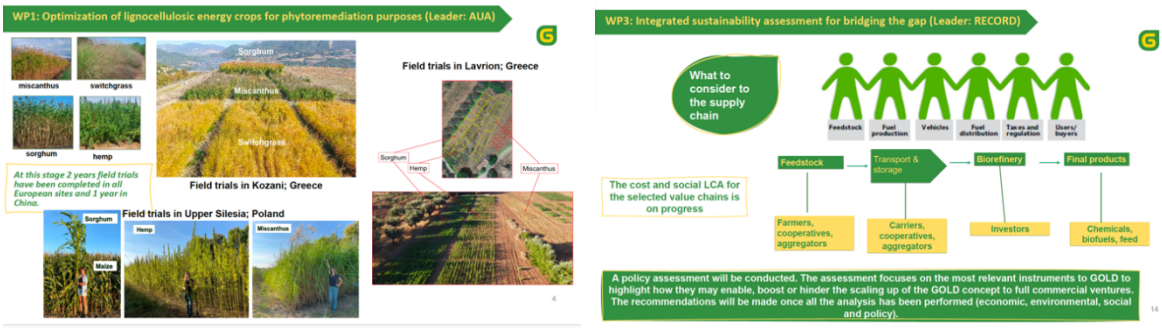

Figure 29: Efthymia Alexopoulou's key messages concerning the GOLD project

Maria Loizidou of NTUA presented the CIRCforBIO & CRONUS projects with a combination of processes which are carried out at the multi-feedstock biorefinery at Lavrion, Greece. In the CIRCforBIO project the key objective is the recovery of oils from food waste. Source-separated bio-waste has also been used and the recovered oil proved to be a suitable raw material for the production of advanced biofuels (biodiesel or SAF). In the framework of CRONUS a functional prototype is operational based on enzymatic capture of CO2 and autotrophic algae cultivation.

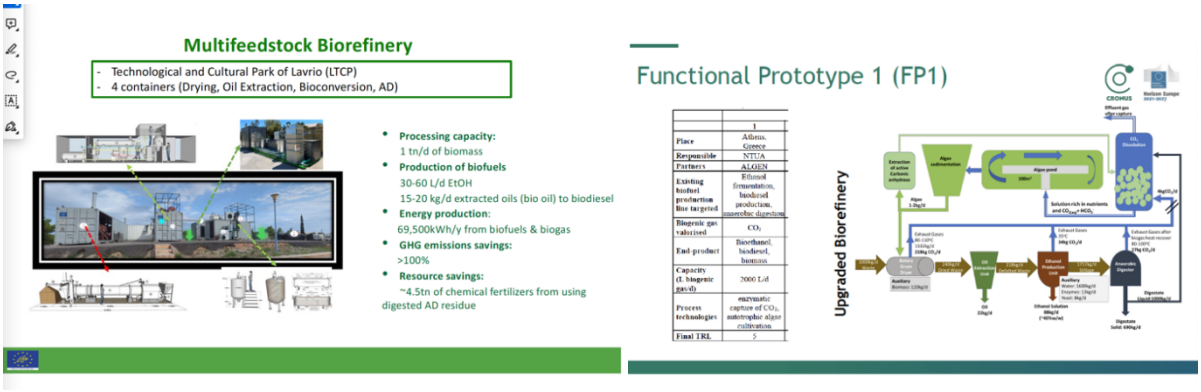

Figure 30: Maria Loizidou's key messages concerning the multi-feedstock biorefinery at Lavrion

Dimitris Kourkoumpas of CERTH presented the BioTheRoS project on novel biofuels based on gasification and pyrolysis. BioTheRoS develops innovative & cost-competitive Fast Pyrolysis-to-biofuels and Gasification-FT-Synthesis value chains, combining Carbon Capture Utilization (CCU) and fuel upgrading for accelerating the scale-up of sustainable biofuels. The fast pyrolysis process is based on the BTG technology while the gasification process is based on the BEST gasification from Austria. The project aims to achieve the validation of the two technologies and the evaluation of the products.

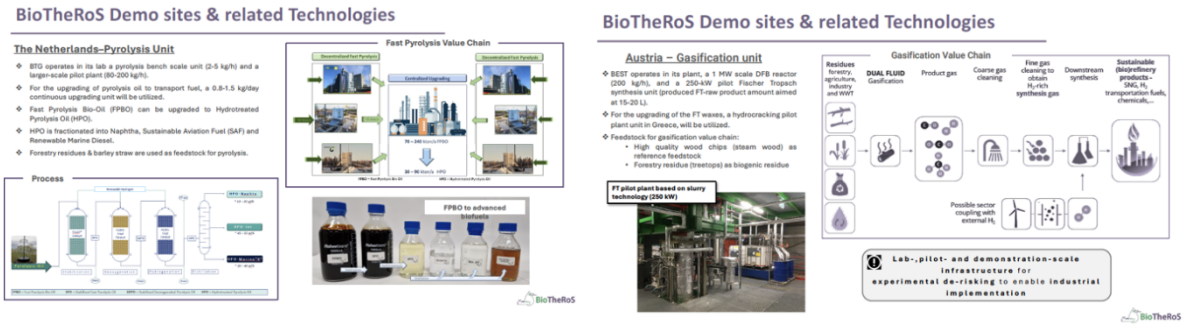

Figure 31: Dimitris Kourkoumpas' key points on the BioTheRoS project

Konstantinos Atsonios of CERTH presented the BioSFerA and FUELPHORIA projects. In the former project the production of new sustainable feedstock for HEFA plans has been demonstrated with GHG emission savings in the range of 48% to 86% compared to conventional fossil fuels. The later project aims to demonstrate the conversion of 75 kg biogenic carbon to be converted to advanced liquid renewable fuel. The final demonstration will target a 30-day gas fermentation run aiming to achieve up to 90% CO2 conversion in the fermenter.

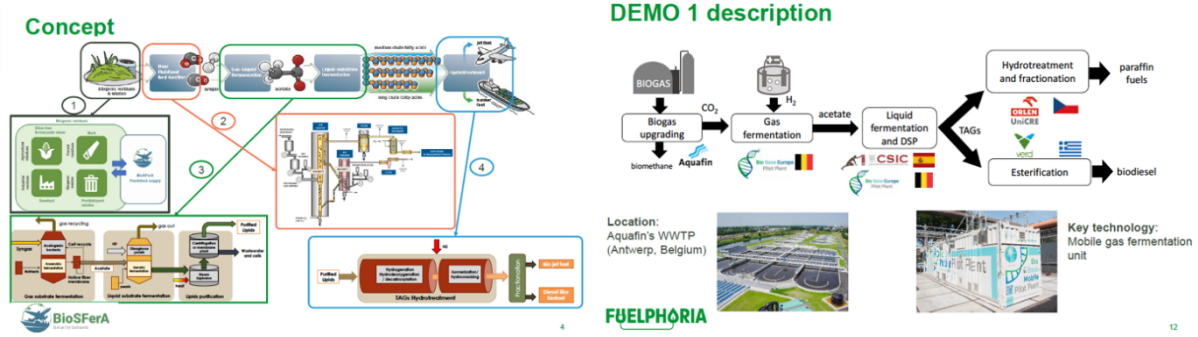

Figure 32: Konstantinos Atsonios' key points on the BioSFerA & FUELPHORIA projects

Stella Bezergianni of CERTH presented the BioMates and ABATE projects. The BioMates is based on ablative fast pyrolysis of straw or miscanthus followed by mild hydrogenation with input of green electricity. The stabilized bio-oil coprocessing was validated with suitable petroleum-derived fractions. Bio Mates can substitute 15 million m^3/yr of crude oil using 75 million tons of biomass (technology limited by sustainable biomass supply).
The ABATE project aims to co-feed 2G biomass produced with reliable properties via novel technologies for refinery coprocessing.

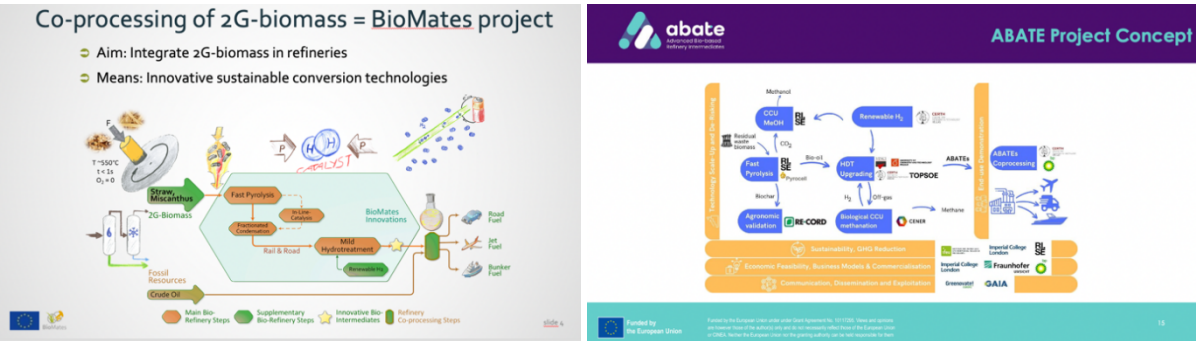

Figure 33: Stella Bezergianni's key points on the BioSFerA & FUELPHORIA projects

Status of SAF Technologies

The status of the SAF technologies presented in this conference are shown in Figure 34. The status is depicted based on the TRL level the technologies have reach at the time of the Conference.

Status of advanced biomass conversion technologies for SAF based on their TRL level

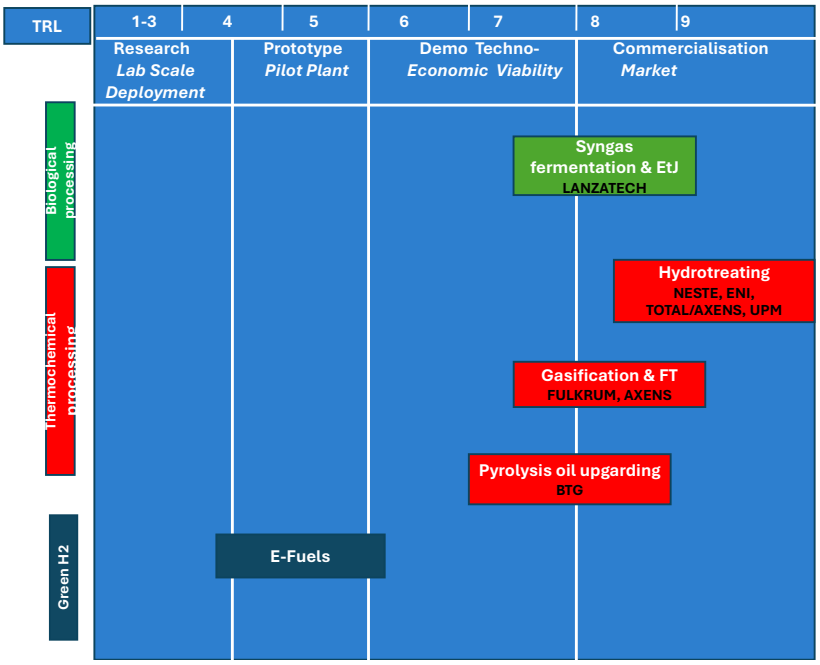

Figure 34: Status of the SAF technologies (adapted from K. Maniatis, "Technology status for advanced biofuels", presentation to CONCAWE, 29/01/21)

Figure 34 shows that the hydrotreating of lipids is the only technology that is commercial with several technology providers and plants in the EU and worldwide; the TRL is >9. Then ethanol to jet and gasification with Fischer Tropsch value chains follow in the TRL level of 7 to 9. Pyrolysis oil upgrading or coprocessing is in the TRL range of 7 to 8.

Finally, since there were few presentations indicating that work on e-SAF is ongoing, e-fuels were added in Figure 34 which at present are in the TRL level 4-6.

While breakthroughs can be expected for ethanol to jet and gasification with Fischer Tropsch in the next year or two, the e-SAF is expected to reach commercialisation in about 8-15 years.

HEFA-SAF

The only commercial SAF technology and value chain is hydrotreating of lipids (oils & fats). There are several plants globally and several technology providers for HEFA-SAF. In the conference such technologies were presented by AXENS and Total Energies, (see presentations by Yvon Bernard and Michael Hecquet, and Figures 19 & 20 respectively). Figure 35 shows photos of some existing HEFA-SAF biorefineries in the EU. It should be noted the NESTE's Rotterdam and UPM's Lappeenranta plants were built as *biorefineries* while those

of ENI's and TotalEnergies's plants are retrofitted petroleum refineries to biorefineries.

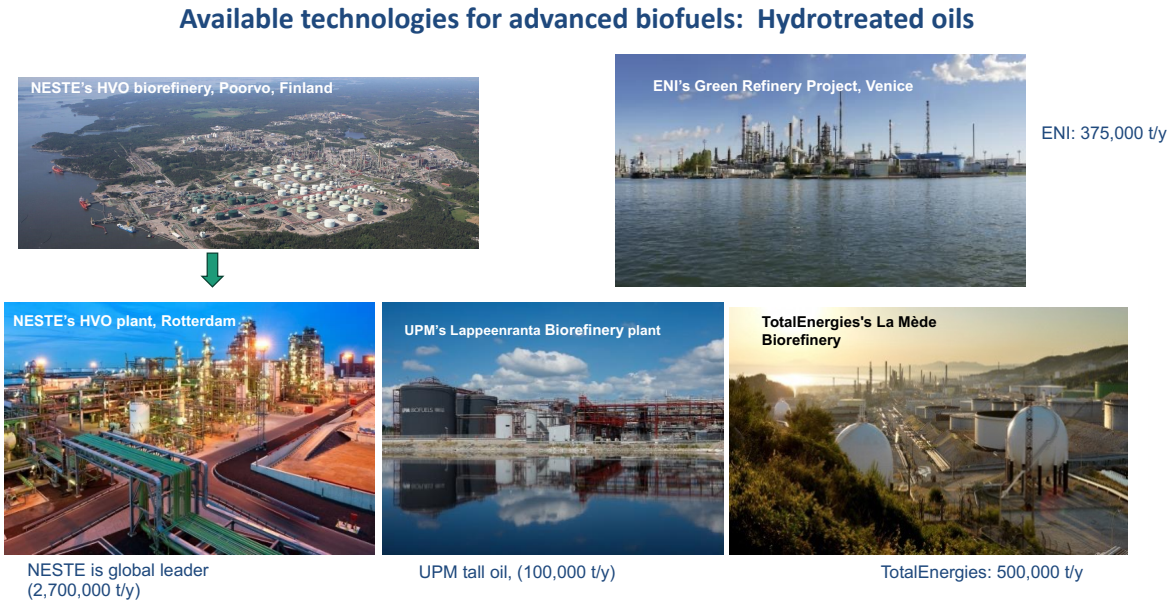

Figure 35: Photos of some existing HEFA-SAF biorefineries in the EU

Alcohol to Jet

AtJ technologies are at very high advanced level and very close to be commercialized. LanzaJet presented this technology in combination with other related technologies with LanzaTech, the mother company, (see presentation by Ronnie Maddox and Figure 21).

Gasification followed by Fischer Tropsch

The gasification & FT technology was presented in the conference by AXENS; see Figure 36. Yvon Bernard reported a confidential project in the US. The main experience of AXENS comes for the demonstration plant in Dunkerque, France; see Figure 36.

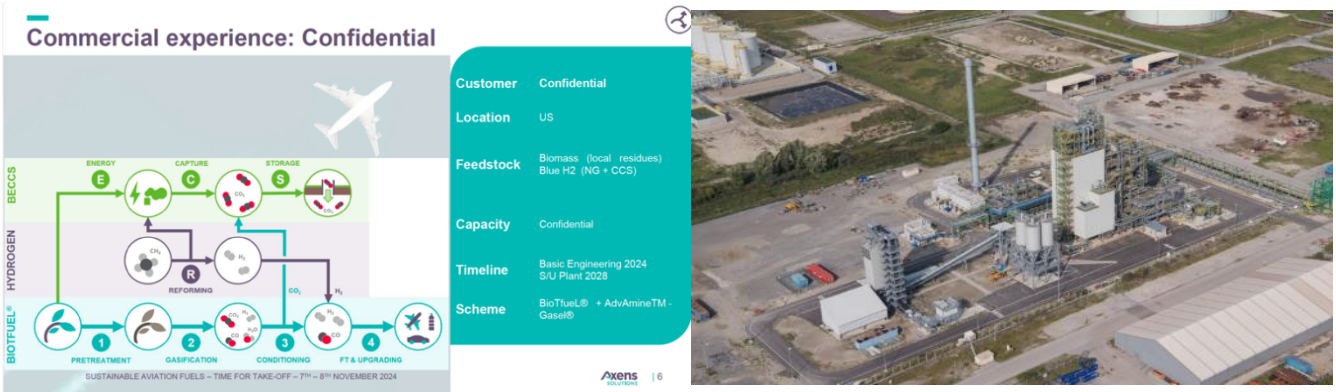

Figure 36: simplified schematic of the AXENS announced plant in the US and photo of the BioTfuel demonstration plant at Dunkerque

The construction and successful operation of the US plant will be a significant step towards commercialisation of the gasification/FT route for SAF[1].

Pyrolysis to SAF

BTG is the leading company in fast pyrolysis of biomass on a global scale and Bert van de Belt presented the technology and the efforts undertaken to upgrade biooil to SAF with the DACIA process. Furthermore, there are some coprocessing plants with valuable results.

Innovative technologies in TRL level<6

Several Horizon Europe projects were presented by Greek institutions in the TRL level of <6. These technologies need quite some further work on all aspects of the value chains and technologies before they can reach a TRL level of >7 and can be considered at demonstration level and closer to commercialisation. Even after reaching the demonstration level, several years of improvements and optimization will be needed before the technology could be considered commercial.

The long-time scale for a technology to reach commercialisation was mentioned by Ronnie Maddox for LanzaJet, see Figure 37. Furthermore, it should also be noted that under the best circumstances it takes between two to three years to build a biorefinery.

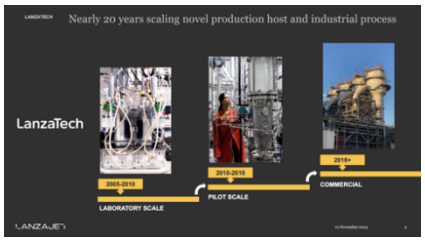

Figure 37: Scaling the LanzaJet process from laboratory scale to commercial.

[1] There was a major setback in this value chain when it was announced in June 2024 that the Fulcrum BioEnergy gasification/ FT plant in Nevada, US was abandoned (https://cen.acs.org/energy/Fulcrum-BioEnergy-abandons-trashfuel-plant/102/web/2024/06).

Analysis of the Questionnaire

Introduction

As mentioned in the Preamble 18 of the speakers and 10 participants submitted the completed questionnaire. The author of this report didn't submit a completed questionnaire to avoid any predisposition on the analysis.

From the 18 speakers 5, and from the participants 8, respectively were Greek. Therefore, 70% of the speakers who submitted the questionnaire were non-Greek and only one of the participants who submitted the questionnaire wasn't Greek. Overall, more than half of the questionnaires analysed were submitted by non-Greek stakeholders. There was general spread of response across the stakeholders on the various questions related to policies and value chains and in these areas one can conclude that the responses represent a "European" position of stakeholders. However, on the questions related to the Greek "SAF ecosystem" there were very few responses by non-Greek stakeholders and therefore in this area one can conclude that the responses represent a "Greek" position of stakeholders.

The analysis was based on responses with a positive (YES), negative (NO), unclear, or no response (N/A). In some of the questions the stakeholders were asked to provide opinions or recommendations; is such questions the analysis was simply based on a comments or N/A. It is not possible to include all comments and recommendations in this analysis, however, the most pertinent ones related to the question were copied verbatim as to provide the reader with some of the key positions from the stakeholders who submitted the questionnaire. Positive positions are in black letters, negative ones in red and unclear in blue.

Analysis of responses

Q1- Q3: On the Conference structure and venue

Q1: Do you consider that the length of the conference (2 days) was appropriate?

90% of respondents replied with YES
7% (or 2) would prefer a 4-day event
Only one respondent would prefer a 1-day event.

Q2: Do you consider that the length of your presentation (recommended 15 min) was appropriate?

82% of respondents replied with YES
3 respondents (about 11%) proposed to have a longer duration of 20 min.
2 respondents (about 7%) provided inconclusive comments.

However, one respondent commented on the 15 min duration of each presentation:

"This has allowed to hear the view of many experts, in an event of a reasonable duration."

Q3: Did you find the venue and catering of appropriate quality?

All respondents apart from one (about 96%) replied with YES.

Conclusions: The structure of the conference was appropriate for the aims and objectives of the event.

Q4: On the REFuel EU Aviation Legislation

Q4.1: Do you consider that the REFuelEU Aviation mandate is the appropriate policy tool to promote SAF?

43% of the respondents replied with YES while 17 replied with NO. 32% of the respondents provided inconclusive comments. Some of the responses are provided below:

"Yes as I think is a good tool to promote SAF."

"Yes as the long term goal is to replace fossil."

"Yes as the long term goal is to replace fossil. No as it is too restrictive."

"For aviation an industry still in nascent stage, mandates are not a realistic starting point."

"I think it is a good step but there should be more involvement of fuel producers, sub-mandates with incentives to push for SAF production."

"Incentives need to come first to help create an ecosystem. Once system is mature mandates can be more effective."

Q4.2: Do you consider that the 6% target is too high?

60% of the respondents replied with NO while 19% replied with YES. 14 % of the respondents provided inconclusive comments while 2 didn't answer the question. Some of the responses are provided below:

"No, this is definitely possible in case we all aim for it and create the right circumstance."

"No, the target in fact is even too low, when envisaging the bigger step towards 2035."

"YES It is high given the EU SAF production capability."

"YES The target of 6% is high."

"Given the challenges the market is facing in both accessing raw materials for SAF production and increasing expenses I'm not sure the target will be met."

"It is an ambitious target."

Q4.3 Do you consider that the time-2030, to meet the target is too soon?

54% of the respondents replied with YES while 29% replied with NO. 14 % of the respondents provided inconclusive comments while 1 didn't answer the question. Some of the responses are provided below:

"Yes, but the policy is a barrier with the complexity to prove that the electricity originates from an additional built renewable power system. This creates inflexibility in a system that is optimised for flexible use."

"Yes, it is achievable. However additional measures are required to kick-start this technology pathway. Also, no distrust in the mandate should be created."

"No. Technologies are NOT mature despite what project developers are saying, and costs (Capex and Opex) are enormous."

"NO Strict policies and incentives towards SAF are mandatory to move away from fossil fuels."

"Technically possible, Policy clear frame has to be set to allow industry invest."

"Concerned will be missed. Project are not moving ahead because of uncertainty of both feed EOH and SAF product pricing."

Q4.4: What would you like to see in the legislation that is now missing?

28% of the respondents didn't provide any answer. Some of the responses are provided below:

"Mandates for market introduction should be accompanied with specific innovation and investment agenda and support measure to ensure the built up of a portfolio of technology pathways, also those that are more capita intense. Market alone will otherwise tend to focus on lower cost options only."

"Penalizations to countries / companies if such targets are not achieved."

"Open up ATJ feedstock to existing 1G EOH. Control new facilities for production of 1G EOH, rather than mandatory use of advanced EOH. More flexibility in using sustainable feedstock crops or imported resources in the EU."

"Actions supporting the user side. Without a clear understanding of the users, and action promoting their involvement, the inevitably increase in the costs is going to lower the implementation of any measure."

"Possibly a clearer role of fuel producers in achieving the blend mandate."

Q4.5: Do you have any other idea to support the legislation/SAF deployment?

Only 15 respondents (54%) answered this question. Some of the responses are copied below:

"Innovation to realise more SAF without using HEFA. Integration of bio-based feeds/intermediates in refineries rendering hybrid aviation fuels with high bio-content."

"A relevant aspect is to support specifically-grown biomass as SAF feedstock, instead of just focusing on residues."

"EU/Government loan guarantees".

"Harmonize implementation of RED with respect to Annex IX - Differences around approved feedstocks at Member State level creates unlevel playing field."

"Stable and enabling policies for biomass supply are needed."

Conclusions: In general, the stakeholders believe that the REFuel EU Aviation Legulation and its targets have a positive effect on the deployment of SAF in the EU, however, the measures and policies are not sufficient to ensure that the targets will be met. Overall, there is belief that the ecosystem has not reached sufficient maturity yet.

Additional measures such as loan guarantees and more stable long term policies are needed.

Q5: On the financial EC tools to support SAF deployment

Q5.1: Did you ever try to apply to the Innovation Fund?

Only 4 respondents (14%) answered this question. Some of the responses are provided below:

"Our company no, our customers yes. It's painful, lengthy, costly and you don't get any exchange with the person in charge of the folder. You receive eventually a notification if you have been granted or not – there should be a clarification meeting at least prior to the decision."

"Yes. Positive experience"

"Yes, for one of our projects. This was a good experience on the process. However there was unclarity on the line between innovation and economic readiness of the technology."

"As consultants, we have supported Clients with the preparation of their application to the IF but not for a SAF-related project. It is a demanding and time-consuming task. However, some of the available guidelines and documentation were quite useful. The debate on "innovation" is something I still find challenging to address in a proposal."

Q5.2: If yes what was your experience?

Noone answered this question. Some of the responses in Q5.1 addressed this question.

Q5.3: If not, why?

Only 12 respondents (43%) answered this question. 4 of them responded with "*National grants*". Some other responses are provided below:

"In France, we have ADEME which is giving subsidies for Capex and for FS/Basic engineering so it helps. Ideas to accelerate : provide bank guarantees."

"All financial tools in the EU are hard to get. Require too much time and resources to apply – with no guaranteed outcome. We are getting this feedback from small companies that cannot afford to apply for EU funds. On the other hand, in the US it is much easier and this is evidenced by the number of active projects."

"A pocket to finance FOAK plants (expensive and risky) is missing."

"Guarantee funds, and stronger burdens on fossil CO2."

Conclusions: The stakeholders have limited experience with the Innovation Fund (IF). Applying to the IF seems to be a complex and expensive process that may limit small companies.

Some stakeholders prefer using national funds and credits which is perceived to be simpler and straightforward process with high probability of successsful outcome.

There is urgent need for dedicated support for First-of-a-kind-Plants (FOAK) as well as additional measures such as loan guarantees.

Q6: On the feedstock availability

Feedstock availability for SAF is critical and global resources for HEFA SAF limited. What would you recommend being done to improve the feedstock availability?

25 respondents (89%) replied to this question. Some of the responses are copied below:

"Improve the logistics of the residual biomass (collection from the fields, transport, pre-treatment) that is available but not efficiently collected. Produce additional biomass by making use of marginal and abandoned lands, as well as by testing several sustainable cropping systems."

"Create a stable and enabling policy framework for biomass. The sustainability framework for biomass should not be re-opened whenever the renewable energy targets are revised."

"Feedstock should be profitable for farmers and forest managers to produce, highlighting the need for financial incentives."

"AtJ SAF: similar on the collection of the feedstock and also on the treatment of feedstock to 2nd generation ethanol. 2nd generation ethanol production is challenging, more research should be performed on that, creating more competition in the market. However, it is difficult to ensure this, since other markets (like US) do support utilization of (cheaper and more abundant) 1st generation ethanol. It would be useful if the rules on this are equal, creating a playing level field."

"A mechanism to secure long term feedstock offtake agreements."

Conclusions: There is general agreement that much more needs to be done concerning feedstock availability. Ensuring the farmer gets additional income; long term feedstock offtake agreements and a stable policy framework concerning biomass sustainability are key messages from the stakeholders.

Furthermore, there is need to create a fair playing level field with US ethanol-to-jet production which is based mostly on food-based crops.

Q7: On technology readiness, innovation & development

Q7.1: Only HEFA SAF is commercially available F-T SAF, AtJ SAF, Fast Pyrolysis to SAF are at various stages of development but still they can't be considered commercial yet. What the EC and Member States can do to accelerate the deployment of such technologies in the market?

Only two of the stakeholders didn't reply to this question. Some of the responses are copied below:

"Technologies are there, at least at TRL 7-8. What is missing is a tool to finance FOAK plants."

"The support system for new technology development (R&D, pilot scale) is very well organized within the European context. However, the upscaling is challenging due to investors risk aversity. Any support system helping this phase of technology adoption would be highly useful to accelerate the deployment of such technologies in the market."

"Build a portfolio innovation and investment agenda (and clear funding support) to allow for project realisation for all pathways."

"More funding opportunities for CAPEX investments and first-of-a-kind projects."

"Provide financial support and any other tool necessary for scaling up."

"Further technology development, piloting and demonstration through a dedicated programme under HE."

Q7.2: What is the role of the oil companies in supporting SAF technology development?

4 respondents didn't answer the question. Some of the responses are copied below:

"Their role is in the blending as they have storages etc. but they are not really opened to collaborate to create new competitors. Oil majors are here to make profit out of their assets, not to support a new sector."

"They should be the ones pushing for technology development. Their involvement is essential to scale up SAF production and make it commercially viable."

"They are the natural processing companies for any hydrocarbons. As long as they only try to protect their fossil oil business, they are the enemy, not the solution. Unless they get forced to invest."

"Be a part of this process and help deploy new technologies. Their experience can be instrumental in scaling up new technologies."
"Pivotal, as main fuel production pilar."

"Their involvement is rather hypocritical; they do not want to lose the aviation fuels market."

"Oil companies should get actively involved and invest in scaling-up SAF producing technologies."

"Unfortunately, they do not contribute enough. They could invest more in SAF technology development (there should be a mandate to force them invest more in this field instead of fossil fuel research)".

Q7.3: Do Airlines have a role to play in supporting SAF technology development?

One stakeholder replied NO while two didn't reply to the question. Some of the responses are copied below:

"They have but limited as it's not their business to build, operate a plant. One of the main need is for them to sign offtake contract (long term, 10 years) in order to enhance bankability of projects."

"Airlines could incentivize oil companies to supply green fuels and thus investing on green fuels and advertise largely in public that they fly with green fuels, so as to advance societal acceptance and advertise largely in public that they fly with green fuels, so as to advance societal acceptance."

"Ideas on how airlines could support SAF development: Long-term Purchase Agreements & Corporate Sustainability Goals. Building Public Awareness."

"They are the users and should be supported to adopt SAF to maintain a healthy sectoral growth and support economy."

"Airlines must commit to longer offtake agreements for SAF."

"They have to crystallize demand, by entering into off-take agreements. They can also support start-ups by investing in equity."

"They can help projects reach FID through offtake contracts"

Q7.4: Is the support provided by Horizon Europe (HE) adequate to support innovation and accelerate the development of SAF technologies?

Only 6 respondents (25%) replied with a YES and one with a NO while 8 (29%) didn't reply. Some of the responses are copied below:

"Yes, I think this is already relevant, but higher TRL projects may be needed. Industry often faces issues because research and policy do not come along. So if HE shows such TRL research interest, this can be used as incentive to push policy and convince industry to participate even with a perspective of application within the EU market"

"Yes, but this can be further optimized."

"No, as the mandate is enforced with only one commercially proven technology available."

"In my opinion it is not. The decision to fund one project depends on the competition at the time of the call and there is rarely a follow up project."

"Yes and NO. Yes, because they finance R&D – but do we really need to develop while there is nothing in construction?"

"More need to support, especially from TRL5-6 to the commercial stage"

"Commercialization efforts must be accelerated"

"As described before, the current support system is adequate for innovation of SAF technologies, however implementation on a larger scale could use some more support"

Q7.5: What would you like to see in the Calls of HE that is now missing?

13 respondents (46%) didn't reply to the question. Some of the responses are copied below:

"Higher TRL actions."

"More support for demonstration (two replies)".

"What is actually missing from HE is long-term project funding that would enable successful research projects to reach maturity."

"A tool to finance FOAK plants."

"The Calls of the framework must have an intermediate call between the pilot and demo and the industrial plant in order to secure the pathway of the industrial upgrade."

"There should be a clear link between the HE project and industrial partners/investors. In most cases currently, industrial partners are not committed to further support the upscaling of the developed technology."

Q7.6: Do you have any other idea to support the structuring of the HE Calls to accelerate technology development?

Only 6 respondents replied to this question. Some of the responses are copied below:

"IA and Demo projects should have specific and mandatory techno-economic and environmental KPIs that each project should address, similar to commercial available technologies."

"The HE calls of high TRL must have obligatory evaluation of the financial plan of the facility construction and not only the evaluation of the Work Packages and the Tasks."

"Measure innovation and measure impact. Have smart people in the structure that are able to distinguish between sense and nonsense."

Conclusions: It is a repeating theme that better designed financial support schemes for FOAK and CAPEX are needed to support the deployment of SAF technologies.

There is general agreement that the role of oil companies is pivotal and they can help deploy new technologies. However, the stakeholders are of the opinion that the oil companies have not fully supported SAF yet, and much more must be done.

Airlines can play a critical role in facilitating SAF market uptake by entering into off-take agreements. They can also support start-ups by investing in equity and help projects reach FID through offtake contracts.

Horizon Europe provides good support for research up to a TRL of 5-6 but above that level more targeted financial support is necessary to facilitate technology commercialisation.

Q8: SAF Development in Greece

Q8.1: Does Greece have the appropriate ecosystem to push through the needed legislation to facilitate SAF deployment?

5 respondents replied with YES while 8 didn't reply. Some of the responses are copied below:

"I was surprised by the fact that so limited activity was yet there in Greece. Even some fuel suppliers don't have access to molecules for 2025, although the mandate is kicking off. I think this conference was very helpful to make the whole industry more aware and it was a very good kick-start for SAF development in Greece."

"The appropriate ecosystem is to have financial support with people knowing the industry to actually finance what can be built."

"Financial support for SAF producers is required, offtake agreements of feedstocks and SAF should be mandated. Supply chains are needed for both feedstocks and SAF."

"The Aviation sector in Greece is not regulated by the state. Greece through the Hellenic Civil Aviation Agency implements the mandates of IATA and ICAO. The

ecosystem is not the case. All the SAF distributed in Greece is imported. Only the blending taking place in the refineries."

"I understood from the conference that a SAF Working Group with relevant actors has been established. This is positive. However, the WG does not seem to address a key component in SAF deployment, which is the biomass supply."
"This is something that currently is missing. Fast adoption of the European policies and legislation and proper framework for support schemes, covering the whole value chain."

"Only recently has SAF appeared in the national energy and climate plan of Greece. No financial incentives and support schemes dedicated to SAF are yet published. Lacking or non-functional feedstock supply chains represent one of the most important barriers."

Conclusions: There is general understanding that a lot of work still has to be done before Greece will have a good and stable ecosystem to push through the needed legislation to facilitate SAF deployment.

Q9: Do the Greek oil companies engage strongly the stakeholders to develop SAF in Greece?

15 (54%) respondents didn't reply the question, while replied there was one YES and one NO. Some of the responses are copied below:

"I believe that recently, the Greek oil companies started to engage strongly the stakeholders to develop SAF in Greece."

"Greek oil companies engage strongly the stakeholders to develop SAF in Greece."

"No, from the 2 big oil companies, one has no plans towards SAF production in Greece, and the other plans to consider a HEFA SAF plant of questionable scale in 3-4 years' time. Real investments towards novel technologies are required and SAF imports need to be limited."

"It seems like SAF developments from Greek oil companies are starting now. However, this will probably not be sufficient for the Greek mandated market. I think there is need for more developments, by actively investing in SAF development and building strong consortiums with airlines guaranteeing offtake."

"There is no production facility in Greece for SAF. A biorefinery will be a starting point but there is no intention from a respectable investor for the time being."

Conclusions: From the responses it appears that the Greek oil companies must improve their communications with the stakeholders on their efforts to develop SAF in Greece.

Q 10: What more steps AEGEAN needs to undertake to accelerate SAF deployment in Greece?

There were 16 (57%) responses to this question and some of them are copied below.

"Create voluntary market, like KLM does. Focus on technology acceptance, as the mandate will render increase of fuel prices that will reflect to the air-ticket prices."

"A voluntary payment offer for customers with sustainability request could help to raise money for SAF production."

"Long term SAF offtake agreements."

"AEGEAN is involved with the developments of SAF supplied by EKO and with the first SAF program in Greece. However, AEGEAN sees many 'challenges' like price volatility of SAF compared to jet fuel due to supply/demand imbalance. However, these challenges can be overcome by signing long term-offtake agreements by fuel suppliers. This is the 'chicken-and-egg' problem: eSAF developers and offtakers pointing towards each other that they are dependent on each other before committing."

"Off take contracts. Make green flying your core business and you will find customers for it. Green flying protects and sustains Greece and its Greece tourist industry."

"Creating further awareness on SAF to key market actors and directly discussing with the Government on the needs to develop the appropriate framework."

Conclusions: The stakeholders expect Aegean to implement a voluntary market and sign long term offtake agreements with developers while at the same time creating further awareness on SAF to key market actors and directly discussing with the Government on the needs to develop the appropriate framework.

Q11: Biomass availability in Greece

Q11.1: What needs to be done to improve the biomass availability in Greece?

There were 19 (68%) responses to this question. Some of the replies are listed below.

"Greece had unexploited biomass that need to be cost and time-efficiently collected. In addition, sustainable growing techniques have to be adopted and incentivized, like the exploitation of marginal and abandoned lands as well as sustainable cropping systems."

"Biomass availability on specific crops for SAF production."

"Incentives to increase cultivation of plants and trees on unused lands."

"Research on mapping biomass feedstock based on technical parameters, market needs, and compliance with environmental policies."

"Supply chains and offtake agreements. Limit SAF imports."

"Can consider MSW gasification."

"The issue with Greece is not biomass availability per se. It is that there are limited experiences in the mobilization of the existing potential and limited incentives to do so. Depending on the biomass to be mobilized, appropriate and specific strategies would need to be defined, as well as allocate support for the establishment of the supply chains."

Q11.2: Which feedstocks are the most appropriate for the Greek agriculture/forestry?
There were 11 (32%) responses to this question. Some of the replies are listed below.

"A trustful carbon management atlas would tell. Everything else is just guessing."

"Appropriate feedstocks from Greece would primarily be herbaceous agricultural residues (e.g. straw) and energy crops. Mobilizing forestry residues and prunings in the scale needed for the deployment of SAF technologies would be much more challenging. Algae remains a question mark for me."

"Firstly residual biomass, both forest and agri, should be fully exploited. Energy crops (both lignocellulosic and non-food oil) should be tested at farming scale, both in marginal lands and under sustainable cropping systems."

Q11.3: Are agricultural operations such as double cropping applicable in Greek agriculture?
6 (21%) respondents replied YES, and 20 didn't reply to this question. One of the two replies is listed below.

"CRES is conducting considerable research on sustainable cropping systems and on growing biomass in marginal lands, in the frame of both finalised projects, such was BECOOL and MAGIC, and even more in the past, and ongoing ones, like GOLD, CARINA, MIDAS, ICARUS, IASIS."

Conclusions: The stakeholders are of the opinion that there are signific ant quantities of unexploited biomass in Greece and it is necessary to provide strong incentives for its collection via supply chains and offtake agreements.

Appropriate feedstocks in Greece are primarily herbaceous agricultural residues (e.g. straw) and energy crops.

Exploitation of marginal and abandoned lands as well as sustainable cropping systems can significantly improve biomass availability in Greece.

CRES has significant experience on sustainable cropping systems and on growing biomass in marginal lands.

Q12: There are several innovative projects like ICARUS coordinated by Greek beneficiaries to develop new SAF technologies. How can the research community in Greece collaborate better with the oil companies to accelerate technological progress and bring the technologies to the market?

There were 16 (57%) responses to this question and some of the replies are copied below.

"This conference showed that the research community collaborates successfully with oil companies, which is a strategy that needs to be further elaborated and enhanced."

"I think there are enough viable SAF technologies today. Focus should be on developing projects with existing viable technologies rather than new technologies."

"I think the current concept of Icarus works very well, many stakeholders representing different parts of society are represented (industry, research, academia, government (national and European)). It is very important to keep industry involved from the beginning. Additional suggestion: I think Greece is the perfect country to look into electric flights as well. Although that is a more long term solution, I think this is very interesting for Greece to already start exploring this option."

"The oil companies in Greece are not innovative."

"The research community and oil companies have the potential to collaborate effectively within the context of R&I initiatives and policy objectives. Key stakeholders to involve include feedstock producers from agriculture, forestry, and municipalities. These groups, have to be persuaded that there is a new developing market for their residues, which will be long-lasting and stable."

Conclusions: It became apparent during the conference that there is sufficient collaboration between the research community and the oil companies in Greece, however, this collaboration needs to be further strengthened.

The ICARUS project is a good example where different stakeholders and the society are

Annexes

Annex 1: Programme of the Conference

Sustainable Aviation Fuels

time for take-off

7-8 November 2024
Athens, Divani Palace Acropolis

Agenda

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Thursday, 7 November 2024
POLICIES and MARKETS

09:30-10:00 ***Registrations***

10:00-10:40 **Opening session**

Welcome by Chair: Dimitris Kardomateas, CRES President and General Director
Theodoros Skylakakis, Minister of Environment and Energy
Alexandra Sdoukou, Deputy Minister of Environment & Energy
Vasilis Oikonomou, Deputy Minister of Infrastructure and Transportation
Prof. Yannis Maniatis, Member of the European Parliament, Vice President of the S&D Group, f. Minister of Environment and Energy
Prof. Nikolas Farantouris, Member of the European Parliament, Jean Monnet Professor of EU Energy Law, f. Chair of Legal, EUROGAS Brussels
Maria Georgiadou, EC Directorate General for Research and Innovation

10:40-12:00 **Session I: International Aviation Developments**

Chairperson: Myrsini Christou
Preeti Jain, Net Zero Transition Programs, IATA *" Decarbonizing Aviation & Role of SAF"*
Matteo Prussi, Politecnico di Torino, EU representative at ICAO *"The role of SAF in the ICAO CORSIA initiative"*
Kees Kwant, Dutch Enterprise Agency *"Integrated Biorefineries Mission as a tool to develop advanced SAF through international collaboration"*
Kyriakos Maniatis, Consultant, f. EC Directorate General for Energy *"Comparative analysis on international SAF policies and markets"*

12:00-12:20 ***Coffee Break & Networking***

12:20-13:20 **Session II: European Policy Developments**

Chairperson: Myrsini Christou
Ewa Oney, EC Directorate General for Transport *"ReFuelEU Aviation policy framework: where are we and what is next"*
Eric Van den Heuvel, studio Gear Up, *"An integrated, multi-sectoral policy support is needed to boost investments on renewable fuels"*
Sergi Alegre, Airport Regions *"Looking the SAF Iceberg: a lot done, a lot to be done"*

13:20-14:00 **Panel Discussion I: *Are we on the right Flightpath?***

Moderator: Eric van den Heuvel
Panelists: Maria Georgiadou, Preeti Jain, Matteo Prussi, Kees Kwant, Kyriakos Maniatis Ewa Oney, Eric Van den Heuvel, Sergi Alegre

14:00-15:00 ***Lunch Break***

15:00-15:40 **Session III: Considerations on National SAF Policy**

Chairperson: Kyriakos Maniatis
Aristotelis Aivaliotis, General Secretary of Energy and Minerals
Christos Tsitouras, Governor D/G Hellenic Civil Aviation Authority *"Refueling Aviation in Greece, HCAA Flightpath towards effective implementation of SAF Regulation"*

15:40-17:00 **Session IV: Practical SAF experiences in Greece**
Chairperson: Kyriakos Maniatis
Spyros Svoronos, Book Leader Domestic Market Motor Oil
Michalis Papazoglou, Director of Refineries Planning & Operation Optimization Division, HELLENiQ ENERGY *"Sustainable Aviation Fuels for the Helleniq Energy"*
Panagiotis Argianas, Aviation Fuels & Services Manager, EKO ABEE HELLENiQ ENERGY *"EKO SAF Experience in Greece"*
Giorgos Govatzidakis, Sustainability Manager, AEGEAN "*AEGEAN – embracing sustainability, our experience to date"*

17:00-17:20 **Panel Discussion II: SAF Opportunities in Greece – What needs to be done**
Moderator: Kyriakos Maniatis
Panelists: Aristotelis Aivaliotis, Christos Tsitouras, George Mitkidis, Head of Alternative & Renewable Fuels Motor Oil, Panagiotis Argianas, Giorgos Govatzidakis

17:20 – 17:40 ***Coffee Break & Networking***

17:40-19:00 **Session V: SAF Global Market situation**
Chairperson: Eric van den Heuvel
Jim Spaeth, US Department of Energy *"US SAF policy and market"*
Eline van Berlo, SkyNRG *"Global SAF markets – Are we on track?"*
Blanca de Ulibarri, Round Table on Sustainable Biomaterials *"SAF sustainability and certification"*
Eleni Liakakou, Ricardo *"The EU SAF Clearing House"*

19:00-19:20 **Panel Discussion III: International aviation readiness to operate with SAF**
Moderator: Eric van den Heuvel
Panelists: Jim Spaeth, Eline van Berlo, Blanca de Ulibarri, Eleni Liakakou

20:30 ***Conference Dinner***

Friday, 8 November 2024
RESOURCES AND TECHNOLOGY STATUS

09:30-09:40 **Welcome by Chairs: Myrsini Christou & Kyriakos Maniatis**

09:40-10:00 **Keynote speech**
Maria Georgiadou, EC Directorate General for Research and Innovation
"Global challenges and European strategy for SAF innovation"

10:00-11:20 **Session VI: SAF commercial technologies**
Chairperson: Kees Kwant

Ralph-Uwe Dietrich, German Aerospace Center "*Towards SAF mass production in Europe – technical opportunities and economic challenges*"
Yvon Bernard, AXENS *"Axens Technologies for Sustainable Aviation Fuels: A Complementary Approach for Achieving Greenhouse Gas Reduction Goals"*
Michael Hecquet, TotalEnergies "*TotalEnergies approach to SAF: current experiences and looking to the future"*
Ronnie Maddox, Lanzajet "*Someday is Now"*

11:20-11:40 ***Coffee Break & Networking***

11:40-12:20 **Session VII: SAF technologies in large scale demonstration**
Chairperson: Kees Kwant
Bert Van De Beld, BTG Bioliquids "Sustainable Aviation Fuel from biomass via fast pyrolysis bio-oil"
Martin Stephan, Global Bioenergies *"From cosmetics to SAF: Fostering the environmental transition through biosciences"*

12:20-13:00 **Panel discussion IV: *Do we have reliable technologies for SAF market deployment?***
Moderator: Ralph-Uwe Dietrich, German Aerospace Center
Panelists: Maria Georgiadou, Yvon Bernard, Michael Hecquet, Ronnie Maddox, Bert Van De Beld, Martin Stephan

13:00-14:00 ***Lunch break***

14:00-14:40 **Session VIII: SAF technologies in innovative development - International cooperation for sustainable aviation biofuels– the ICARUS project as Greek SAF Incubator"**
Chairperson: Maria Georgiadou
Myrsini Christou, CRES *"Sustainable feedstock for SAF production"*
Francisco Girio, LNEG "*The biocrude to SAF pathway" tbc*
Ikker Aguirrezabal, EHU/EUS *"The alcohols to SAF pathway"*
Yadi Ganjkhanlou, TNO "*The syngas to SAF pathway"*

14:40-15:40 **Session IX: SAF technologies in innovative development (a)**
Chairperson: Maria Georgiadou
Myrsini Christou, CRES *"Bioenergy, biogas and biofuels: Research and innovation gaps in the EU – EERA Position Paper"*
Efthymia Alexopoulou, CRES *"Bridging the gap between phytoremediation on growing energy crops on contaminated lands and clean biofuel production within GOLD project"*
Maria Loizidou, NTUA, *"The role of Bio-Oil, Bioethanol and Algae for Sustainable Aviation Fuels – pathways developed within LIFE CIRCforBIO and HORIZON CRONUS projects"*

15:40-16:00 ***Coffee Break & Networking***

16:00-17:00 **Session X: SAF technologies in innovative development (2)**
Chairperson: Myrsini Christou

Dimitris Kourkoumpas, CERTH *"Collaborative Actions to Bring Novel Biofuels Thermochemical Routes into Industrial Scale within the BioTheRos project"*
Konstantinos Atsonios, CERTH *" "Advanced biofuels and renewable fuels for Aviation and maritime from a sustainable value chain within FUELPHORIA project"*
Stella Bezergianni, CERTH *"Hybrid biofuels from bio-based intermediates refinery integration – BioMates & ABATE projects"*

17:00-17:20 **Panel discussion V: Where do we stand with innovation in SAF technologies?**
Moderator: Maria Georgiadou
Panelists: Myrsini Christou, Francisco Girio, Ikker Aguirrezabal, Yadi Ganjkhanlou, Efthymia Alexopoulou, Maria Loizidou, Dimitris Kourkoumpas, Konstantinos Atsonios, Stella Bezergianni

17:20-17:30 **Closing remarks**
Myrsini Christou, Kyriakos Maniatis

Supporting projects

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Annex 2: List of Participants

Sustainable Aviation Fuels - Time for Takle off
Athens 7 & 8 November 2024
List of Participants

N°	Surname	Name	Organisation
1	Aguirrezabal	Iker	University of the Basque Country
2	Aivaliotis	Aristotelis	Ministry of Environment and Energy
3	Alegre	Sergi	Airport Regions Council
4	Alexopoulou	Efthymia	Centre for Renewable Energy Sources and Saving (CRES)
5	Amygdalou	Loukia	AUSTRIAN Embassy Athens
6	Anamaterou	Evdokia	Athens International Airport
7	Angelopoulou	Anastasia	Motor Oil Hellas
8	Argianas	Panagiotis	Helleniq Energy
9	Atsonios	Kostis	Centre for Research & Technology Hellas (CERTH)
10	Bernard	Yvon	AXENS
11	Bezergianni	Stella	Centre for Research & Technology Hellas (CERTH)
12	Boukis	Ioannis	TEREC
13	Cerone	Nadia	ENEA
14	Chalaris	Antonis	PricewaterhouseCoopers
15	Chatzifotis	Konstantinos	Motor Oil Hellas
16	Chazilias	Dimitris	EKO Helleniq Energy
17	Chounta	Pavlina	Motor Oil Hellas
18	Christakopoulos	Fanis	Motor Oil Hellas
19	Christou	Myrsini	Centre for Renewable Energy Sources and Saving (CRES)
20	Chrysanthopoulou	Lalela	POWERGAME/ENERGYGAME websites
21	Chrysikopoulou	Konstantina	HELLENIC AVIATION SERVICE PROVIDER
22	Damatis	Nikolaos	Hellenic Biomass Association (HellaBiom)
23	Daskalakis	Georgios	Motor Oil Hellas
24	de Ulibarri	Blanca	The Roundtable on Sustainable Biomaterials (RSB)
25	Dietrich	Ralph-Uwe	Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR)
26	Domine	Marcelo E.	Instituto de Tecnología Química (ITQ, UPV - CSIC)
28	Farmaki	Georgia	AEGEAN Airlines
29	Ganjkhanlou	Yadolah (Yadi)	Netherlands Organisation for Applied Scientific Research (TNO)
30	Gavriil	Loukas	Centre for Renewable Energy Sources and Saving (CRES)
31	Georgiadou	Maria	European Commission, DG RTD
32	Gile	Teresa	US Embassy Athens
33	Girio	Francisco	LNEG-National Laboratory for Energy and Geology
34	Goumas	Theodor	EXERGIA S.A.
35	Govatzidakis	Giorgos	AEGEAN Airlines
36	Grannitsiotis	Georgios	Motor Oil Hellas
37	Hecquet	Michael	TotalEnergies
38	Iordanoglou	Konstantinos	Centre for Renewable Energy Sources and Saving (CRES)

39	Jain	Preeti	International Air Transport Association (IATA)
40	Kakagia	Afroditi	Centre for Renewable Energy Sources and Saving (CRES)
41	Karampinis	Manolis	Bioenergy Europe
42	Karapanagiotis	Nicolas	Centre for Renewable Energy Sources and Saving (CRES)
43	Kardomateas	Dimitris	Centre for Renewable Energy Sources and Saving (CRES)
44	Karytsas	Kostas	Centre for Renewable Energy Sources and Saving (CRES)
45	Katsampiris	Marios	Motor Oil Hellas
46	Kiamos	Georgios	EKO Helleniq Energy
47	Kirkilis	Dimitris	Motor Oil Hellas
48	Konemann	Jan Willem	TNO
49	Korma	Efi	Centre for Renewable Energy Sources and Saving (CRES)
50	Kourkoumpas	Dimitrios-Sotirios	Centre for Research & Technology Hellas (CERTH)
51	Kravariti	Evi	Centre for Renewable Energy Sources and Saving (CRES)
52	Kwant	Kees	RVO, Dutch Ministry of Climate and Green Growth
53	Liakakou	Eleni	RICARDO
54	Loizidou	Maria	National Technical University of Athens
55	Lykou	Georgia	Hellenic Civil Aviation Authority
56	Maddox	Ronnie	Lanzajet
57	Malamis	Dimitris	National Technical University of Athens (NTUA)
58	Mamalakis	George	International Air Transport Association (IATA)
59	Maniatis	Kyriakos	Independent Consultant, Low Carbon Fuels
60	Maniatis	Yannis	Member of the European Parliament, Vice President
61	Mantelis	Dimitrios	GIZ
62	Mantogiannis	Vassilis	PricewaterhouseCoopers (PWC)
63	Maravelaki	Anna	Motor Oil Hellas
64	Markakis	Manolis	HELLENIC PETROLEUM R.S.S.O.P.P. S.A.
65	Mitkidis	George	Motor Oil Hellas
66	Mitsia	Athina	HELLENIC PETROLEUM R.S.S.O.P.P. S.A.
67	Moschopoulou	Maria	EKO Helleniq Energy
68	Moschovou	Eleni	EKO Helleniq Energy
69	Mpakogianni P	Maria	EKO Helleniq Energy
70	Mpoultouka	Triantafilia	HELLENiQ ENERGY Holdings A.E.
71	Ntaras	Nikos	Centre for Renewable Energy Sources and Saving (CRES)
72	Oconnor	Michael	Athens international Airport S.A
73	Oney	Ewa	European Commission, DG MOVE
74	Panagiotaki	Anastasia	HELLENIC PETROLEUM R.S.S.O.P.P. S.A.
75	Panaretou	Vasiliki	Motor Oil Hellas
76	Papadis	Konstantinos	Motor Oil Hellas
77	Papamichail	Ioanna	Centre for Renewable Energy Sources and Saving (CRES)
78	Papazoglou	Michalis	Helleniq Energy
79	Paralika	Athina	Centre for Renewable Energy Sources and Saving (CRES)
80	Passadis	Konstantinos	National Technical University of Athens (NTUA)
81	Prussi	Matteo	Politecnico di Torino (POLITO)
82	Psalti	Maria	Motor Oil Hellas
83	Psiaki	Maria	EKO Helleniq Energy

84	Roumanas	Christos	AEGEAN Airlines
85	Sagani	Angeliki	Centre for Research and Technology Hellas (CERTH)
86	Sdoukou	Alexandra	Deputy Minister of Environment & Energy
87	Sgourou	Eva	Hellenic Aviation Service Provider
88	Siampali	Konstantina	EKO Helleniq Energy
89	Simitou	Iro	Centre for Renewable Energy Sources and Saving (CRES)
90	Siouris	Spiridon	University of Sheffield
91	Soulakis	Diomidis	Aristotle University of Thessaloniki (AUTH)
92	Spaeth	Jim	US Department of Energy
93	Spanou	Vasiliki	Hellenic Civil Aviation Authority
94	Stamos	Vasilis	HELLENIC PETROLEUM R.S.S.O.P.P. S.A.
95	Stefanidis	Stelios	Centre for Research and Technology Hellas (CERTH)
96	Stephan	Martin	GLOBAL BIOENERGIES
97	Svoronos	Spyros	Motor Oil Hellas
98	Tsiadis	Giorgos	Centre for Renewable Energy Sources and Saving (CRES)
99	Tsitouras	Christos	Hellenic Civil Aviation Authority
100	Tzoulaki	Despina	Grant Thornton Greece
101	van Berlo	Eline	SkyNRG
102	Van de Beld	Bert	BTG Biomass Technology Group BV
103	van den Heuvel	Eric	Studio Gear Up B.V.
104	Vougiouklakis	Yannis	PricewaterhouseCoopers (PWC)
105	Vourliotakis	George	EXERGIA
106	Zafiris	Christos	Centre for Renewable Energy Sources and Saving (CRES)
107	Zafiropoulou	Paraskeui	HELLENIC PETROLEUM R.S.S.O.P.P. S.A.
108	Zannias	Yannis	AI-Grow
109	Zarkadoula	Maria	Centre for Renewable Energy Sources and Saving (CRES)
110	Zimbardi	Francesco	ENEA

Annex 3: Questionnaire send to speakers and participants of the conference

"Sustainable Aviation Fuels – Time for take-off"
Conference, Athens, 7-8 November

Questionnaire to Speakers & Participants

Although I would expect you to complete the questionnaire, please note that you are not obliged to answer all questions.

Please note that the analysis will be **anonymous**. Your submissions will **only be seen and analysed** by Dr Kyriakos Maniatis.

The questionnaire is in WORD format. Please chose your response by making your choice **bold and/or type your responces**.

General			
Your Name			
Your Organisation			
On the conference structure & venue			
Q1	Do you consider that the length of the conference (2 days) was appropriate?	YES	NO
	If not, would you prefer to be shorter or longer	Shorter	Longer
Q2	Do you consider that the length of your presentation (recommended 15 min) was appropriate?	YES	NO
	If not, please specify the length you think appropriate in min		
Q3	Did you find the venue and catering of appropriate quality	YES	NO
	If not, please specify what you think needs improvement		
On the REFuel EU Aviation Legislation			
Q4	Do you consider that the REFuelEU Aviation mandate is the appropriate policy tool to promote SAF?		
	Do you consider that the 6% target is too high?		
	Do you consider that the time-2030, to meet the target is too soon?		
	Do you consider that the target of 1.2% by 2030 of synthetic aviation fuel is achievable?		
	What would you like to see in the legislation that is now missing?		

	Do you have any other idea to support the legislation/SAF deployment?	
On the financial EC tools to support SAF deployment		
Q5	Did you ever try to apply to the Innovation Fund? If yes what was your experience? If not, why?	
	Did you ever try to apply to the InvestEU-EIB fund? If yes what was your experience? If not, why?	
	Is there any other financial tool that you think would accelerate the deployment of SAF in the EU?	
On the feedstock availability		
Q6	Feedstock availability for SAF is critical and global resources for HEFA SAF limited. What would you recommend being done to improve the feedstock availability? For HEFA SAF? For F-T SAF? For AtJ SAF?	
On technology readiness, innovation & development		
Q7	Only HEFA SAF is commercially available. F-T SAF, AtJ SAF, Fast Pyrolysis to SAF are at various stages of development but still they can't be considered commercial yet. What the EC and Member States can do to accelerate the deployment of such technologies in the market?	
	What is the role of the oil companies in supporting SAF technology development?	
	Do Airlines have a role to play in supporting SAF technology development?	
	Is the support provided by Horizon Europe (HE) adequate to support innovation and accelerate the development of SAF technologies?	
	What would you like to see in the Calls of HE that is now missing?	
	Do you have any other idea to support the structuring of the HE Calls to accelerate technology development?	
SAF Development in Greece		
Q8	Does Greece have the appropriate ecosystem to push through the needed legislation to facilitate SAF deployment?	

	If not what needs to be done to meet the targets of the REFuelEU Aviation mandate?	
Q9	Do the Greek oil companies engage strongly the stakeholders to develop SAF in Greece? If not what needs to be done?	
Q10	What more steps AEGEAN needs to undertake to accelerate SAF deployment in Greece?	
Q11	What needs to be done to improve the biomass availability in Greece?	
	Which feedstocks are the most appropriate for the Greek agriculture/forestry? Traditional residues? Energy crops? Algae?	
	Are agricultural operations such as double cropping applicable in Greek agriculture? Are there ongoing activities?	
Q12	There are several innovative projects like ICARUS coordinated by Greek beneficiaries to develop new SAF technologies. How can the research community in Greece collaborate better with the oil companies to accelerate technological progress and bring the technologies to the market? Are there other key stakeholders that the research community can engage?	

Annex 4: List of submitted questionnaires

Sustainable Aviation Fuels - Time for Take off

Athens 7 & 8 November 2024

Submitted Questionnaires

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N°	Surname	Name	Organisation
1	Aguirrezabal Telleria	Iker	University of the Basque Country
2	Alegre	Sergi	Airport Regions Council
3	Bernard	Yvon	AXENS
4	Bezergianni	Stella	CERTH
5	Christou	Myrsini	CRES
6	de Ulibarri	Blanca	RSB
7	Dietrich	Ralph-Uwe	DLR
8	Ganjkhanlou	Yaddi	TNO
9	Jain	Preeti	IATA
10	Kourkoumpas	Dimitrios	CERTH
11	Kwant	Kees	RVO NL
12	Liakakou	Eleni	RICARDO
13	Lykou	Georgia	Hellenic Civil Aviation Authority
14	Maddox	Ronnie	LANZAJET
15	Prussi	Matteo	Politecnico di Torino
16	Stephan	Martin	Global Bioenergies
17	van Berlo	Eline	SkyNRG
18	van den Heuvel	Eric	studio Gear Up

Participants

N°	Surname	Name	Organisation
1	Gile	Teresa	US Embassy Athens
2	Goumas	Theodor	EXERGIA
3	Kalligeros	Stamatis	Hellenic Naval Academy
4	Karampinis	Manolis	Bioenergy Europe
5	Gavriil	Lukas	CRES
6	Mantelis	Dimitrios	GIZ
7	Papamichail	Ioanna	CRES
8	Tzoulaki	Despina	Grant Thornton Greece
9	Vourliotakis	George	EXERGIA
10	Zimbardi	Francesco	ENEA