Summary per topic based on the questions received during the Workshop in Addis Ababa on SAF (July 2023).

Note: SAF – Sustainable Aviation Fuels including Low Carbon Aviation Fuels and other cleaner energy for aviation.

SAF Production and Roll-Out in Africa

Sustainable Aviation Fuel (SAF) has the potential to play the pivotal role in achieving the Long-Term Aspirational Goal (LTAG) by ICAO with the aviation's stated ambition to reach net zero carbon emissions by 2050.

In the context of this overarching goal, the transition to Sustainable Aviation Fuel in Africa presents a dynamic interplay of challenges, strengths and immense opportunities. Questions related to the SAF production and roll-out in Africa cover topics like development and harmonization of policies, most promising feedstocks, most feasible production pathways and related process technologies, the setup of bio refineries and related infrastructure, realistic production expansion plans, and the overall vision of SAF production in Africa.

In the African context, developing and harmonizing policies, improving infrastructure readiness, overcoming financing hurdles and the required build-up of technical expertise of people and institutions are challenges to be met. Additionally, there is the crucial task of aligning SAF initiatives with diverse regional policies and economic landscapes. Yet, these challenges are set against a backdrop of immense regional strengths. Africa's diverse ecology and climate offer a competitive advantage in the form of a vast array of potential feedstocks. Agricultural residues, non-food crops like Jatropha, and waste oils such as Used Cooking Oil (UCO) present significant opportunities for the continent. The activation of existing feedstock potentials could lay the foundation of a prospering SAF production and related economy.

Harnessing these feedstocks efficiently could position Africa not merely as a SAF consumer, but as a global SAF production hub. In conclusion, while the road to mainstreaming SAF in Africa has its share of obstacles, informed strategies drawing from global lessons and leveraging local strengths can pave the way for a sustainable and economically robust aviation future for the continent.

International technical cooperation programs such as from EASA demonstrate that for SAF capacities to be effectively ramped up, a multi-stakeholder approach is essential covering the whole SAF value chain with defined SAF roadmaps on country and integrated African continent level. Key lessons encompass the importance of integrating localized production strategies based on an optimal match of SAF production technologies and available, sustainable feedstocks. EASA’s support offers tailored capacity building as a continuous way to share best practice and to foster the establishment of harmonized policies to generate a stable regulatory environment for all stakeholders, here from feedstock providers to fuel producers, investors, airports, infrastructure operators and finally aircraft operators.

SAF (Sustainability) Certification and Standards

SAF approval and certification verifies the fuel's compatibility with current aircraft engines and its sustainability. The latter ensures that the fuel produced meets stringent criteria, including a reduction in life-cycle greenhouse gas emissions, and avoids negative impacts such as deforestation or competition with food sources. Moreover, certification offers airlines, regulators, and passengers' confidence that the fuel they are using is both environmentally responsible and technically sound.

The inclusion of Sustainable Aviation Fuels within the ASTM framework is crucial for their commercial adoption, as airlines, engine manufacturers, and regulatory agencies rely on these standards to ensure safety and compatibility. Here, ASTM D7566 - Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons – is the primary specification that deals with SAF. It plays a vital role in the commercial deployment of SAF and, once approved, every novel production pathway is added to this standard. SAFs produced from approved pathways can be blended with conventional jet fuels up to a certain percentage, which is defined in the specification. The blended product must meet the requirements of ASTM D1655, the specification for conventional jet fuel.

While technical standards like ASTM ensure fuel compatibility and performance, various global sustainability standards guarantee that SAF aligns with broader environmental and societal goals. RSB (Roundtable on Sustainable Biomaterials) offers a stringent multi-faceted certification, ensuring that SAF amongst others conserves biodiversity, reduces greenhouse gas emissions, respects human rights, and fosters local economic benefits. Furthermore, ISCC (International Sustainability & Carbon Certification) provides a similar broad certification system as well. It underscores a transparent chain of custody, GHG savings, and land rights. Several voluntary sustainability schemes exist, with ISCC and RSB being the two schemes officially recognized under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

CORSIA, an initiative by ICAO, is a global market-based measure designed to offset international aviation CO_2 emissions to stabilize the levels of such emissions from 2020 onwards (CNG2020), making SAF an indispensable tool. It emphasizes significant GHG savings, biodiversity preservation, and sustainable feedstock production.

The book and claim principle allows for the separation of sustainability attributes from the physical SAF product. This means that for each unit of SAF produced, a certificate is generated. Airlines can then purchase these certificates, thereby claiming the environmental benefits of SAF, even if they use conventional fuel.

While this approach offers flexibility for airlines and fuel producers and can potentially expand the SAF market, concerns need to be mitigated. It must be ensured that stringent

verification standards and processes are in place and applied. As of now, this system is still in its developmental and piloting stage within the SAF industry. Initiatives, like EU's RefuelEU Aviation and ICAO's CORSIA, are evaluating such methods, but widespread consensus and implementation remain under discussion. The system's effectiveness will rely heavily on a robust training and capacity building program for SAF stakeholders, a strong oversight and genuine commitment from the aviation sector.

Policy, Regulations, and Strategy for SAF

The development, production and deployment of Sustainable Aviation Fuels (SAF) is significantly influenced by policies and strategies at various governance levels. Nationally, many countries have implemented SAF mandates and tax incentives to promote SAF. In Africa, countries like Ethiopia have recognized the potential of SAF, incorporating it within broader renewable energy and climate change mitigation strategies. Other countries like Kenya and Nigeria are considering review of policies to incorporate SAF production in their national energy policies.

On a regional scale, institutions like the African Union have begun to recognize the significance of SAF, especially considering Africa's unique bio-resource potential. Initiatives to harness indigenous feedstocks, such as jatropha and waste biomass, can boost regional bio-economies while ensuring aviation's lower carbon footprint. Collaborative research and development, facilitated by regional cooperation, can also pave the way for tailored SAF solutions suited to Africa's diverse environments. The African Civil Aviation Commission's (AFCAC) initiative to accelerate the development, production and deployment of SAF in Africa has identified development and harmonization of policies as a key objective that will enable production of SAF in the continent.

Globally, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) by the International Civil Aviation Organization (ICAO) stands out. This market-based measure sets out to neutralize the growth in CO_2 emissions from international aviation beyond 2020 levels. As member countries engage in offsetting aviation emissions, SAF becomes a viable strategy, offering a tangible reduction in carbon emissions. For African countries, participation in CORSIA can stimulate the domestic SAF industry, driving investment, research, and infrastructural development.

On a regional level, the ReFuelEU initiative as part of the European 'Fit for 55' package sets out provisions aimed at increasing the production and deployment of sustainable aviation fuels, while creating a level playing field through a harmonised European approach. The package aims to enable the EU to reduce its net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and to achieve climate neutrality in 2050. It includes mandatory shares of sustainable aviation fuels to be available at airports, starting at 2% of overall fuel supplied by 2025 and reaching 70% by 2050. It also includes mandatory Renewable fuels of non-biological origin (RFNBO) sub-quotas starting at 0.7% in 2030 and 35% in 2050.

In conclusion, the push for SAF deployment is a complex interplay of various policy-driven motivations, ranging from environmental concerns to economic opportunities. For Africa, with its vast bio-resource potential and growing aviation sector, SAF not only represents a pathway to greener skies but also an opportunity for sustainable economic growth. Embracing SAF, underpinned by robust national, regional, and global policies, can position Africa as a significant player in the sustainable aviation narrative.

Financing and Economic Aspects of SAF

Research has shown that the production cost of Sustainable Aviation Fuels tends to be higher than the production of conventional jet fuel. The reasons include higher feedstock and technology costs. Furthermore, many SAF production facilities are currently smaller in scale compared to conventional refineries, lacking economies of scale and are not geographically widely spread out at the global level. This translates into up to five times higher costs and consequently prices for airlines when purchasing SAF. Depending on market dynamics, regulatory requirements, and incentives, airlines might or might not transfer these costs to consumers. Especially cargo customers and business passengers who have a higher willingness-to-pay for this so-called green premium. This is often driven by self-commitments following the Science Based Targets initiative (SBTi), playing a more and more important role of the businesses' strategies and long-term visions addressing requests e.g., from the customer base and financing institutions. The Science Based Targets initiative (SBTi) encourages businesses to set ambitious carbon reduction targets in line with the latest scientific data and understanding. The primary objective is to ensure that the private sector plays a significant role in keeping global warming to well below 2°C above pre-industrial levels, as established by the Paris Agreement. It encourages private businesses to pursue efforts to limit the temperature increase even further to 1.5°C.

The financing sector plays a pivotal role in advancing the development, production and deployment of Sustainable Aviation Fuels (SAF). Given the current green premium associated with SAF, financial instruments can bridge the gap between its higher costs and the more competitive pricing of conventional jet fuel, making SAF more competitive and cost-effective. Here, the financing sector can fund early-stage R&D efforts focused on breakthrough technologies or efficient feedstock utilization, which can lower the production costs of SAF. When it comes to higher technologically mature SAF production technologies, achieving economies of scale is critical for reducing costs. Financial institutions can offer here capital-intensive grants, loans or investment packages to States or companies looking to expand SAF production, thereby driving down per-unit costs.

Green bonds, specifically designated for environmentally beneficial projects, can be issued to fund SAF initiatives. Likewise, ESG (Environmental, Social, Governance) financing focuses

on sustainable investments, making SAF projects more attractive to socially-conscious investors.

Furthermore, financial institutions can act as intermediaries or participants in Public Private Partnerships, helping to fund infrastructure or projects that benefit both the public and private sectors, like large-scale SAF production facilities or research centers or provide direct technical support and capacity enhancement in SAF project design. Instruments like carbon credits or trading schemes can be integrated into financing models. As airlines or businesses purchase these credits to offset emissions, the revenue can be channeled into SAF development and deployment.
Overall, long-term investments into SAF production requires a stable and harmonized policy support that e.g., ensures a consistent demand for SAF and hence production capacity to drive economies of scale.
To summarize, the financing sector can accelerate the transition to SAF by reducing financial barriers, incentivizing research, and fostering an environment conducive to investment and innovation. A proactive and supportive financial sector will be crucial for SAF's broader acceptance and economic viability.

Capacity Building, Training, and Research

Capacity building in the context of Sustainable Aviation Fuel in Africa aims at empowering individuals, institutions, and communities by equipping them with the necessary skills, knowledge, resources, and infrastructural capabilities to research, develop, produce, and deploy SAFs. This encompasses fostering a robust regulatory framework, promoting industry-academia partnerships, and facilitating access to funding and technology. Capacity building ensures that Africa can harness its unique resources and potential to create a self-sustaining, locally-adapted, and globally competitive SAF industry, while aligning with the continent's broader environmental, economic, and social goals.

Here, the role of academia in Africa could be two-fold. Firstly, educational institutions can provide targeted training initiatives, creating a skilled workforce best trained in SAF technologies and best practices. Secondly, universities and research institutions can be the nexus for SAF research, driving innovations tailored to African contexts and resources. While there are global funds dedicated to SAF research and innovation, collaborations between African nations, international organizations, and the private sector can additionally amplify funding opportunities, ensuring that Africa's SAF trajectory is both sustainable and self-reliant. The AFCAC initiative on the creation of centres of excellence in various African countries can be leveraged on to ensure SAF training is available to a large group of stakeholders and institutions.

Sustainability and Environmental Impacts

Sustainability in the context of SAF means producing and using aviation fuels that not only reduce greenhouse gas emissions compared to conventional jet fuel but also avoid other negative environmental, social, and economic impacts.

It could be summarized by the following three aspects:

- Environmentally: Reducing life-cycle carbon dioxide and non-CO2-emissions, conserving biodiversity, preventing deforestation, and reducing water and land footprints.
- Socially: Ensuring local communities benefit through job creation and improved livelihoods, upholding human rights, and avoiding displacement or adverse impacts on indigenous peoples.
- Economically: Creating stable, long-term job opportunities contributing to economic growth without undermining other crucial sectors like food production.

Multiple organizations and initiatives exist which have developed sustainability standards and criteria. Some key standards and initiatives, as well as the organizations or policies behind are the following:

- Roundtable on Sustainable Biomaterials (RSB) is an international multi-stakeholder initiative that offers amongst others SAF related certification. Its standard covers sustainability criteria, including greenhouse gas (GHG) emissions reductions, biodiversity protection, and social considerations.
- International Sustainability and Carbon Certification (ISCC) provides a certification system for the sustainability of agricultural and forestry products, bioenergy, and bioplastics. It addresses environmental, social, and economic aspects, ensuring that biomass is not sourced from land with high biodiversity or carbon stock.
- The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) by the International Civil Aviation Organization (ICAO) is a global market-based measure to address CO_2 emissions from international civil aviation. SAF can be used to offset a portion of an airline's CO_2 emissions under CORSIA, provided they meet the specified sustainability criteria.
- Sustainable Aviation Fuel Users Group (SAFUG) consists of airlines committed to accelerating the development and commercialization of SAF. SAFUG members pledge to work on sustainable fuel development that does not compete with food, freshwater, or lead to deforestation or other negative impacts.
- RED II (Renewable Energy Directive II) from the European Union sets out the sustainability criteria and greenhouse gas emissions saving criteria, which include SAF. It emphasizes indirect land-use change (ILUC) considerations and places restrictions on feedstocks, e.g., sourced from deforested land.

It's important to note that while these standards and organizations set criteria and guidelines for SAF sustainability, the implementation and impact can vary based on regional factors, policies, and market dynamics. The compatibility, coexistence, and mutual recognition of these standards across different jurisdictions can also pose challenges and opportunities for the global as well as African adoption of SAF.

The Role of Green Energy Projects in SAF

Green hydrogen, produced using renewable energy sources, holds high promises for Africa, particularly given its abundant solar and wind resources. Especially the Power-to-Liquid or PtL pathway shows a very promising potential with less restrictions on the feedstock side. Green hydrogen, produced through the electrolysis of water using renewable energy, can be combined with carbon dioxide (CO_2) captured directly from the air or from point sources to produce liquid hydrocarbons, such as synthetic jet fuel. PtL SAF produced using green hydrogen could significantly reduce the carbon footprint of aviation, the technology and infrastructure challenges need to be addressed. A combination of different SAF pathways, tailored to regional resources and capacities, might be the most effective and efficient approach to decarbonize aviation in the near term.

Many governments, in Africa and elsewhere in the world, have recognized the potential of renewable energy and have initiated policies, incentives, and projects to stimulate growth in this sector. National renewable energy targets, feed-in tariffs, and Power Purchase Agreements (PPAs) are some mechanisms through which governments are driving renewable energy projects.

On the other side, the private sector plays a significant role in renewable energy expansion in Africa as well. International companies, local enterprises, and public-private partnerships (PPP) have been instrumental in driving many of the continent's most significant renewable energy projects. The declining cost of solar and wind technologies has also made private investment increasingly attractive.

Many renewable energy projects in Africa benefit from the support of international development agencies, financial institutions, and partner countries. These entities often provide funding, technical expertise, and capacity-building support. For instance, institutions like the World Bank, African Development Bank, and International Renewable Energy Agency (IRENA) have supported various initiatives across the continent.

In conclusion, the expansion of solar, wind, and green hydrogen projects in Africa could benefit from a collaborative effort between public initiatives and private enterprises, supported by international corporations. Given the continent's vast renewable resources and growing energy demands, these collaborations are crucial for achieving sustainable energy goals. As the global urgency to address climate change intensifies, it's anticipated that investments and projects in these sectors will continue to grow.