Incentives to Ramp-up Decentralised Production of Power to Liquid Sustainable Aviation Fuels

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Introduction

The global aviation industry is responsible for 12% of carbon dioxide (CO_2) emissions from all transport sources and produces around 2.1% of all human-induced CO_2 emissions. In order to achieve the transition from fossil fuels to carbon-neutral alternatives, sustainable aviation fuels (SAF) are indispensable. Unfortunately, these fuels are currently available neither in sufficient quantities at all relevant locations, nor at competitive prices.

Germany is very committed to address this challenge, investing domestically and also promoting global and local initiatives. To create a vibrant market for Power to Liquid SAF (PtL SAF), many actors need to test and adapt technologies for their domestic needs. A good example is the Brazilian-German cooperation project *ProQR – Climate-neutral Alternative Fuels* that promotes small production plants of PtL SAF, located close to remote airports. The efforts of local producers may create even bigger impact if they were connected in a global system. Hence, the *Power-to-X-Hub*[1], a center of excellence for renewable hydrogen and Power-to-X (PtX) technologies, is exploring opportunities for fostering a global book and claim system to pave the way for international PtL SAF ramp-up.

No doubt, PtX products are crucial to defossilise aviation; but they are not sustainable per se. Reliable sustainability standards are essential to unlock a truly sustainable PtX production. They can reinforce trust to develop regional and international markets and ensure financial support. These standards must also support ecosystem integrity, economic prosperity, social inclusion, decent work, as well as transparency and public acceptance. Establishing and enforcing international standards for PtX products and processes is thus an urgent but also a complex task.

PtX Sustainability

The PtX Hub has developed a framework aiming at capturing and understanding the different dimensions relevant for sustainability assessments at different levels and at every step of the value chain. The EESG framework covers four basic dimensions: Environmental, Economic, Social and Governance. For each dimension, sustainability concerns are identified and grouped together in four clusters, as illustrated in Figure 1.

1 The PtX-Hub and ProQR are cooperation projects implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, commissioned on behalf of the German Ministry of the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the Ministry for Economic Affairs and Climate Action (BMWK). They are part of the International Climate Initiative (IKI), supported by BMUV on the basis of a decision adopted by the German Bundestag.

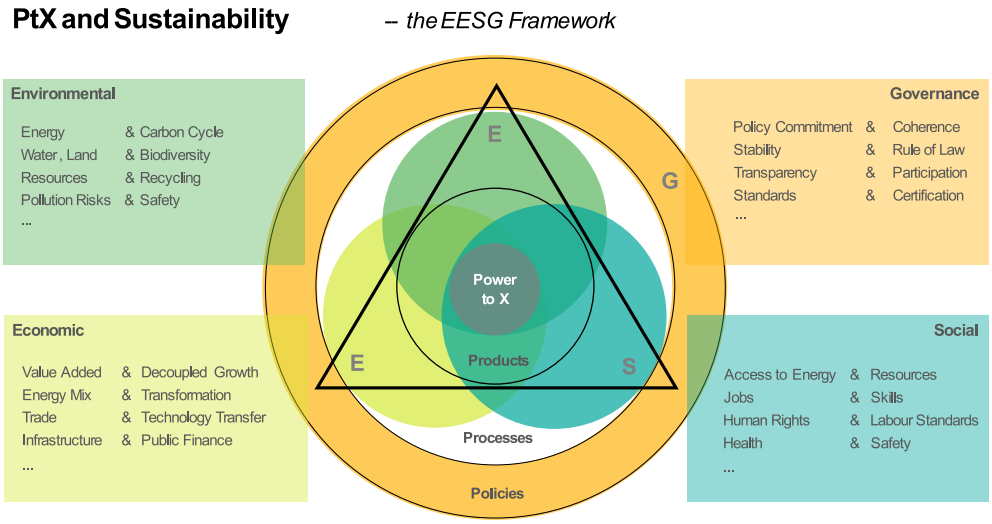

FIGURE 1: The Economic, Environmental, Social and Governance Reference Framework[2]; *©PtX-Hub*

The relevance of each cluster within the framework should be screened in a risk based due diligence process. Whether for a PtX project, a product, a process or a policy, the weight of each cluster must be contextualised, and will be key for the development of transparent and reliable international and local PtX markets.

With regard to e-kerosene the origins of electricity, water and carbon matter. Electricity should be renewable. It should also be additional, ensuring that PtL production does not undermine countries' energy transformation. Water management should avoid increases in regional and local water stress. Carbon for PtL Synthesis should ideally stem from closed carbon cycles.

Book and Claim

The deployment of PtX technologies in developing countries and emerging economies presents substantial potential for the development of new sustainable value chains. It not only offers an economic opportunity but could develop into a cluster for social innovation, jobs creation and advance education. The local production of SAF would improve resilience against oil price volatility, currency exchange rate fluctuations and further delays associated with import logistics. It will contribute to the countries´ energy sovereignty and would enable new local markets. Several developing countries count on the best conditions to produce sustainable aviation fuels.

Now, beyond the potential for local markets, international commitments and ambitious targets are posing political pressure over the aviation industry, especially in industrialized countries. In this regard, a reliable market of sustainable products presents another opportunity for developing countries. A "Book and Claim" system would enable the market, overcoming the challenges posed by the different geographic locations of demand and supply sources.

SAF can be most cheaply produced in areas with high renewable energy potential, such as Australia, South Africa, the Gulf countries or Chile. But instead of transporting this fuel to airports worldwide, it´ll be much better if it can be used as closely as possible to the production site. An airline that needs to fulfil a certain SAF-quote (as being proposed by the European Commission in the amendment of the ReFuelEU Aviation) or wishes to reduce its carbon footprint voluntarily could pay the price difference and then claim the CO_2 reduction. So, while the actual SAF may be filled into a tank of a different plane, the airline paying the premium-price still gets the credit. This would be possible if a registry, managed by a third party subject

2 The EESG Reference Framework can be found on the PtX Hub website (http://www.ptx-hub.org)

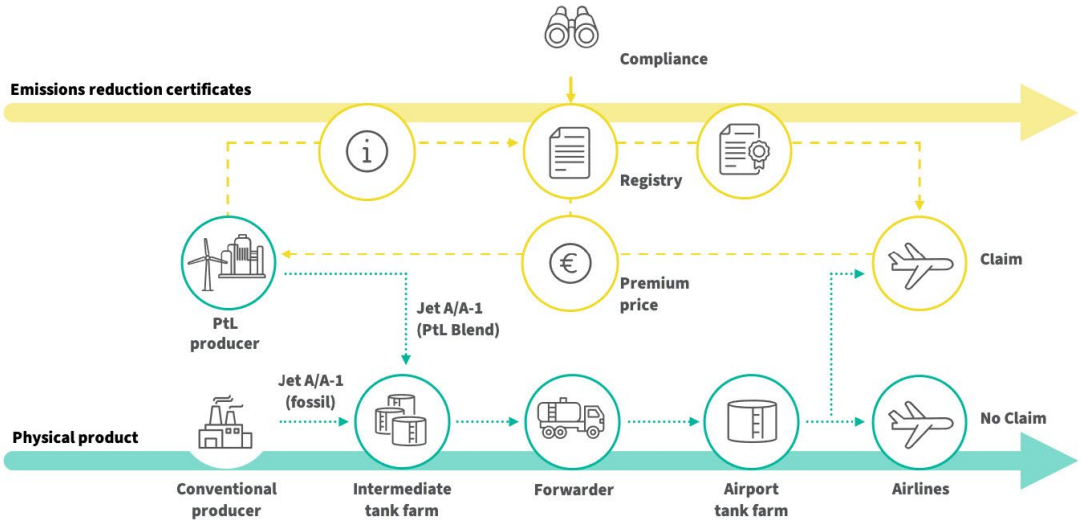

FIGURE 2: Schematic illustration of a book&claim system

to independent audits and checks, issues guarantees of origin (GoO) to SAF-producers. Those can be traded and monitored in a global system that avoids double counting of avoided emissions or double counting of green fuel usage as illustrated below.

Concretely, a SAF-supplier generates a sustainability certificate based on the physical environmental attributes of SAF and enters it into a SAF registry. An operator can purchase the sustainability certificate from the supplier, the transaction is recorded in the SAF registry while the physical delivery is separated (book&claim). The registry ensures transparency and prevents double claiming. Formalized and standardized documentation and tracking methods will ensure trust and auditability in the process.

Such a system has several advantages compared to a mass-balance system, a system still favoured by the European Commission. A mass-balance system implies that the SAF must be physically transported to all airports which involves transportation costs and additional greenhouse gas emissions. Either in an upstream step or at the airport, the SAF will be blended with fossil-based kerosene and then delivered to the various aircrafts. Attributing SAF to a single plane would imply running two separate fuel systems at the airport – a highly inefficient system.

The logistical challenge of providing SAF to various airports also gives undue advantage to large providers. Plants that may be able to produce only small quantities of SAF and deliver it only to an airport in its vicinity would be disadvantaged. One may also lack harnessing the potential of investments in SAF worldwide, including in many developing and emerging countries. With the associated benefits to the local economy.

Lastly, under a book&claim system, an airline could sell the certificates to its business clients and customers. Companies that are committed to net-zero supply chains and private customers that want to fly with zero emissions attached, could shoulder the premium that can be associated to them (eg via calculating kerosene use per seat or weight). In other words, demand for SAF would not only arise from airlines fulfilling their obligatory quota but also from clients using the service of aviation.

This system works best if many suppliers participate. But producing bio-based kerosene or PtL aren´t trivial. Therefore, GIZ fosters small and decentralized production plants to enter the market, such as in the case of Brazil.

Brazil's potential for decentralized SAF production

Brazil today has a promising future in the production of green hydrogen and SAF. Besides having 80% of its electricity matrix composed by renewable energy, the country presents an enormous availability of freshwater resources and a huge potential of solar and wind energy

production still little explored. Another important factor to be taken into consideration regarding the defossilization of aviation in Brazil is that GHG emissions do not only occur in air traffic, but also during fuel transportation to airports. Brazil is a country of continental proportions, and a large number of Brazilian airports are located in remote areas distant from fuel supply centers. Those locations are completely dependent on precarious highway or waterway transportation, or even airplanes to supply the kerosene.

In this context, the German-Brazilian technical cooperation project *ProQR – Climate-neutral Alternative Fuels* promotes the production of SAF in a local, decentralized and modular way: small production plants, located closely to the airports to produce the fuel where it's needed. The project favors the the Power-to-Liquid (PtL) approach, where the SAF synthesis process uses only renewable electricity, water and CO_2 captured directly from the atmospheric air (DAC) to produce the fuel. Studies have shown that such small-scale application is economically feasible in Brazil, taking into account the fuel transport cost to remote regions.

At the same time, other routes based on industrial waste or by-products have huge potential in the country. For example, in Brazil the ethanol fermentation standards produce almost pure CO_2, so that instead of DAC the carbon could be used from the ethanol sector. Also, the glycerine that is a by-product of Biodiesel production can be used to produce syngas, which is then to be converted into Crude and SAF. A research plant for this route is being installed at the SENAI Institute of Innovation (ISI-RE) in Natal with support of the GIZ project H2Brasil.

Brazilian decision makers have recognized those potentials during the past years when discussions about the production and use of green hydrogen and its derivatives became increasingly prominent to make the country's energy matrix cleaner. In 2021, the government instituted the Fuel of the Future programme, with a subcommittee specifically linked to the topic of SAF. Coordinated by the Brazilian Ministry of Mines and Energy (MME), the programme proposes the creation of public policies to boost the production and use of sustainable and low-carbon-intensity fuels. Also, in 2021, a law was signed to create the National Biokerosene Program; its main objective is to promote research and production of SAF.

FIGURE 3: Fueling at Brazilian Airport; ©GIZ Brazil / Soninha Vil

ProQR and its project partners in the Brazilian Ministry of Science, Technology and Innovations (MCTI) and the German Aerospace Center (DLR) accompany the process since the beginning with their expertise. Their studies serve as inputs for the working groups within the current political programmes. Also, teaching material and trainings are being offered to universities and key institutions in the aviation and fuel sector, to pave the way for a well-trained work force and decisionmakers in this innovative field. Furthermore, ProQR is facilitating a network of institutions that result in more pilot plant projects being in the pipeline.

The example of ProQR in Brazil is just one of many initiatives in developing, emerging and industrial countries that together have the potential to create a vibrant global market for SAF. With all adhering to the same industry standards and being governed under one global system, significant contribution can be made to make aviation more sustainable. Join GIZ and the PtX-Hub to push the boundaries and enter new territory!