aireg Aviation Initiative for Renewable Energy in Germany e.V.

Germany as a leading market for sustainable aviation fuels (SAF)

Strategy paper

1 Introduction

aireg – the Aviation Initiative for Renewable Energy in Germany e. V., is committed to the immediate and consistent introduction of sustainable aviation fuels (SAF)[1] as a key lever for making aviation in Germany as climate-neutral, competitive and ultimately sustainable as possible.

aireg sees itself as a competence network and open transformation platform whose members develop new approaches and innovative concepts for the realization of these ambitious targets for using SAF. In doing so, aireg is committed to four subject areas, as described below (Figure 1).

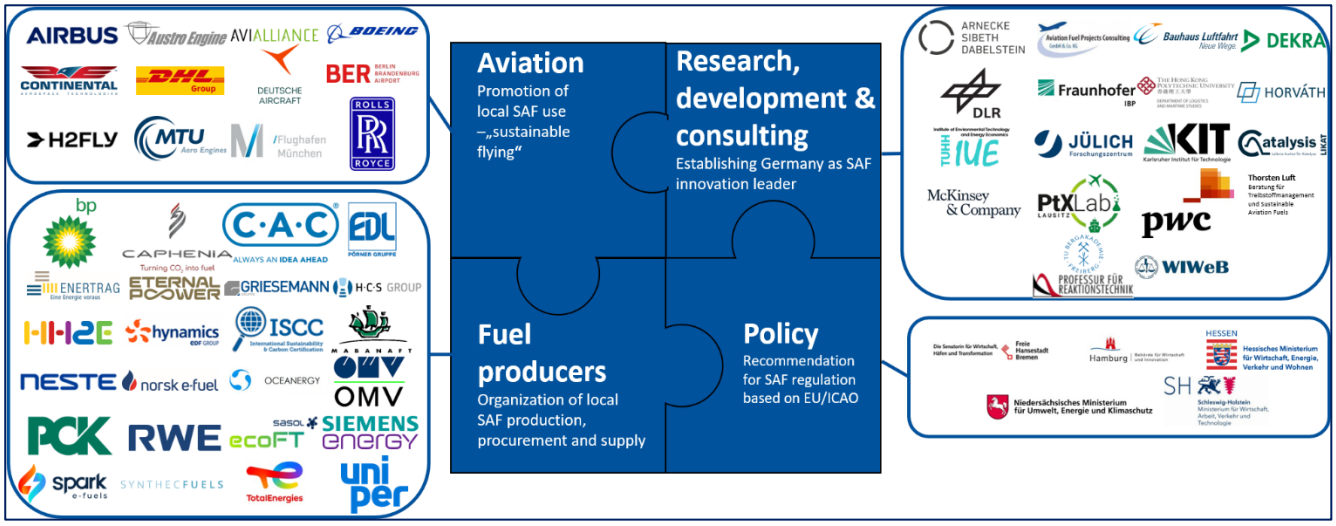

Figure 1 The four subject areas of aireg

2 What does aireg stand for?

2.1 Achieving the international climate targets in aviation

With a view to make aviation as climate-neutral as possible, a rapid and sustainable market ramp-up of SAF is compulsory from a climate protection point of view. aireg is committed to ensure that Germany plays a leading role in this and acts as a role model. In the context of the target pursued by the International Air Transport Association (IATA) and the International Civil Aviation Organization (ICAO) of achieving net CO_2 neutrality in aviation by 2050*, aireg specifically supports the following international targets:*

- The use of SAF as a decisive lever for achieving the climate targets in aviation. On the one hand, SAF can reduce climate-impacting CO2 emissions by over 90% and, on the other hand, it is expected that SAF - compared to fossil kerosene - will also help to significantly reduce non-CO_2 effects on the climate (e.g. particles, contrails).
- Implementation of the international targets set by the EU, ICAO and IATA for the SAF market ramp-up in order to achieve the corresponding climate protection targets. This includes actively developing and innovatively shaping the regulatory framework at national, European and international level.

[1] *The definition from ReFuelEU is used below; for more detailed information on SAF technologies, see aireg Roadmap.*

- Development of further conversion routes and fuels with improved climate compatibility. This includes both biomass-based and electricity-based fuels (including hydrogen); for systemic reasons, further development should focus on innovative combinations of both options, since this can maximize carbon use efficiency.

The targets set by the ICAO at the end of 2023 of a 5% CO_2 reduction in aviation fuels worldwide by 2030 also highlight the *urgency of a rapid market ramp-up*. By way of comparison: less than 1% of the global aviation fuel requirement is currently available as SAF. For this reason, a more ambitious, global development of an SAF industry is required over the next 5 to 10 years if the reduction targets politicians focus on are to be achieved. Against this background, aireg and its members, amongst its sister organization CAAFI in the USA, see themselves as a leading international initiative that *demands and promotes* a *rapid market ramp-up of SAF production with a focus on Germany and the EU.*

2.2 Germany as a leading market for SAF

Germany is in an excellent position to provide technological support for the development of an SAF industry and to play an active role in shaping it worldwide. Germany is not only the largest aviation market in Europe, the center of European aviation research (e.g. DLR) and a hotspot for aircraft production. The country also has large and systemically relevant refinery capacities for its own fuel supply and an internationally leading industrial base in important production areas such as chemicals, energy and plant engineering. In addition, the Federal Republic of Germany also has a very well-developed research infrastructure that has produced many well-trained engineers.

As an open transformation platform, aireg's target is to make Germany a pioneer for sustainable flying through high SAF usage, i.e. to contribute to achieving a high proportion of SAF added to fossil kerosene nationally and thus a correspondingly low CO_2 load/passenger in the near future. Such a high level of SAF use in Germany also directly promotes the second target of technology leadership in the future market of SAF. This will not only ensure a long-term supply of air traffic in Germany, but also secure employment and prosperity in the energy sector, in industry, in air traffic and further beyond. As a competent technology provider, Germany is creating the conditions to offer such systems on the international markets in the future and thereby contribute to international climate protection - while at the same time generating added value in Germany.

Specifically, aireg has set itself the following ambitious SAF utilization targets in order to establish Germany as the leading SAF market (Figure 2).

Year	EU SAF blending quotas	aireg SAF-Utilization targets (Germany)	EU PtL blending quotas	aireg PtL-utilization targets (Germany)
2025	2 %	**2 %**	0.5 % (only Germany 2026)	**0,5 %**
2030	6 %	**10 %**	1,2 %	**3 %**
2035	20 %	**30 %**	5 %	**20 %**
2050	70 %	**100 %**	35 %	**50 %**

Figure 2: Blending rates from ReFuelEU compared with the aireg SAF usage targets for Germany

With these utilization targets, aireg sees itself in a pioneering role in promoting a rapid ramp-up of SAF usage. In this context, *aireg also* supports the *implementation of ambitious climate protection and SAF introduction targets by airlines and airports operating in Germany*, i.e. aireg supports the targets of its members to significantly reduce CO_2 emissions. DHL, for example, plans to use 30% sustainable fuels (SAF) in its air freight business by 2030. This makes an important contribution to climate protection in air transport and demonstrates that greenhouse gas reduction in air transport is technically possible, economically feasible, ecologically beneficial and socially acceptable.

A high level of SAF use in German aviation is also a key factor in enabling Germany to achieve *a leading global role in the development and production of SAF* (*technology leadership*). Here, aireg sees good opportunities for Germany as a high-tech location to become the global technology leader in production of SAF and in particular of PtL-SAF[2]. This is also supported by the fact that Germany is aiming to play a leading international role in the hydrogen economy and in the development and expansion of hydrogen-based energy systems. In this context, the following measures are essential to ensure that these utilization targets can be achieved with a high probability in the coming years.

- Special financial support for PtL-SAF significantly above the EU blending quotas. Despite the as yet unproven large-scale industrial maturity of the technology and the currently (still) significantly higher relative production costs, PtL-SAF offers great long-term potential to substantially reduce the climate impact of air traffic and make a significant contribution to more sustainable global air traffic.

- *Specific promotion of all sustainable SAF production paths* (including HEFA, co-processing, PtL, ATJ, BtL)[3] in order to contribute to the safe achievement of the short-/ medium-term EU blending quotas in particular and at the same time reduce technological and economic risks during the SAF market ramp-up.

[2] In the following, "Power-to-Liquid" SAF (PtL-SAF) refers to renewable fuels of non-biogenic origin (RFNBO) in accordance with EU REDIII. Sustainably produced hydrogen plays a key role here.

[3] HEFA - Hydroprocessed Esters and Fatty Acids; ATJ - Alcohol-to-Jet; BtL - Biomass-to-Liquid

- Review and, if necessary, adaption of the regulatory framework for the use of sustainable raw materials for SAF production, as well as appropriate consideration of local SAF production in the national biomass strategy. For example, raw materials that are suitable for HEFA-SAF production or co-processing should be used increasingly for the local production of aviation fuels in order to help meeting the SAF quotas targeted in Germany and the EU (2% in 2025, 6% in 2030, 20% in 2035) and contribute to achieving climate protection targets in this way.

3 The role of aireg in relation to the most important interest groups

3.1 Air traffic - Broad promotion of SAF use

In order to make German air traffic more sustainable and competitive, aireg stands for the *local use of SAF at German airports* beyond *the EU quota* and for *the development of innovative approaches to the procurement, marketing and distribution of SAF* by its members in Germany and internationally.

For the successful market ramp-up of SAF, the contractual obligation of airlines to (potential) SAF producers to purchase larger quantities of SAF over a longer period of time is of considerable importance (e.g. long-term binding offtake agreements). Although, the number of such "offtake agreements" has increased significantly internationally in recent years, the scope of such contracts and their level of commitment must be increased significantly further in order to achieve the desired utilization targets - and thus the corresponding greenhouse gas reduction. Some airlines (e.g. United Airlines, Norwegian Air Shuttle) are even going one step further and taking stakes in SAF producers, i.e. they are taking additional entrepreneurial risks in order to be able to exert more influence on the development of the SAF ramp-up. aireg expressly supports such innovative approaches to the procurement and distribution of SAF, as this can significantly support the rapid market ramp-up and thus the de-fossilization of global air traffic.

For the significantly increased use of SAF, a self-confident commitment of the aviation sector to SAF combined with long-term, resilient commitments to the (local) further development, procurement and *local use of SAF at internationally competitive prices* is crucial. The particular importance of SAF as the essential and most important solution component for the most climate-neutral air travel possible must also be presented and discussed much more widely and attractively in public. This can significantly increase the awareness of air travelers and air freight users that by purchasing (additional) SAF in connection with the respective service of the air transport industry, they are making a significant contribution to environmental protection and climate relief, and consequently increase the willingness of customers to purchase SAF. aireg supports its members in the implementation of such an ambitious climate policy with ambitious and innovative SAF usage targets and concepts.

Internationally valid and transparent or traceable sustainability standards for SAF in conjunction with an internationally recognized and accepted trading system for SAF certificates are essential elements of an effective and sustainable international SAF market. This also allows the separation of the physical distribution of SAF and the corresponding sustainability claim of the airline and the end customer (short and medium term book & claim). *Therefore, aireg actively supports these and further developments, as well as an international*

harmonization and improvement of these standards in cooperation with individual members and international institutions (e.g. ISCC, ICAO). Without such instruments, which are recognized and accepted by the industry and the administration, it will be very challenging to achieve the desired market ramp-up at national, European and global sphere in a comprehensive and timely manner.

3.2 Fuel production - accelerate ramp-up

aireg supports the establishment and expansion of internationally competitive SAF production in Germany. The corresponding activities with regard to fuel production can be assigned to two objectives: (a) the target of Germany's technology leadership primarily in the area of PtL-SAF and (b) securing ambitious production targets for all sustainable SAF raw material and technology options.

In order to achieve technology leadership in PtL-SAF, *a global PtL-SAF supply chain to Germany with a capacity of 2 million t/a by 2035* needs to be *established*. Of this, up to 25 % (i.e. approx. 0.5 million t/a) of PtL-SAF should be provided in local/ domestic integrated production in order to build up critical know-how in plant operation locally and develop it further from an efficiency point of view. Due to the significantly more favorable framework conditions and thus the expected cheaper production of "green" hydrogen abroad, the remaining 75 % (i.e. approx. 1.5 million t/a) of PtL-SAF would probably have to be imported as PtL syncrude or hydrogen derivative (e.g. eMethanol) from suitable countries by 2035. *aireg supports SAF producing, SAF plant constructing and engineering companies operating in Germany in the implementation of the outlined PtL-SAF ramp-up strategy*.

In order to achieve these production targets for the SAF ramp-up as a whole, the refinery capacities for fossil kerosene currently available in Germany (approx. 5 million tons a year) can be partially transformed and used in such a way that they can efficiently process renewable raw materials into SAF. *In particular, a high proportion of SAF raw materials approved for co-processing can make the ramp-up of SAF cheaper and accelerate it significantly.* This can contribute to security the supply in Germany, create an ecosystem for SAF innovation and develop synergies with other sectors. This can contribute to the further development of technology and build up know-how that can then be marketed internationally for comparable tasks.

In addition, aireg is promoting the expansion of other REDIII-compliant SAF technology paths in order to achieve the local production targets. If the ramp-up of PtL-SAF is successful, at least 10% (approx. 1 million tons a year) of total kerosene consumption in Germany will be required as additional amount of SAF from other technologies in 2035. This means that the utilization targets proposed by aireg can be met and the EU quotas exceeded. It is to be expected that HEFA-SAF, as a technology that is already well established on the market today, will also play an important role in mid-term and can potentially provide the largest quantities. However, the potential of other options such as alcohol-to-jet (AtJ), methanol-to-jet (MtJ) and other conversion processes should also be promoted.

aireg supports SAF producing, SAF plant constructing and engineering companies in the evaluation of the respective site conditions for the construction, conversion and operation of SAF plants. In principle, aireg also supports the development of procurement strategies that allow the necessary, REDIII-compatible raw material quantities to be made available at home and abroad in the long term.

3.3 Research, development and consulting

Technology-open research and development on SAF is essential to enable and secure Germany's long-term technological leadership in sustainable aviation fuels. In this context, aireg focuses on the *extensive development/ improvement/ optimization of plant, process and system technology for SAF production and the promotion of an ecosystem for comprehensive SAF innovations*.

The further technical optimization of SAF (e.g. as part of the DLR technology platform Power-to-Liquid in Leuna or through the BMBF-funded Care-O-Sene project) should enable additionally technical, systemic, economic and ecological improvements to SAF in short and mid-term. In particular, technology and process engineering potentials *that can further significantly reduce* the production costs *for SAF* are to be scientifically researched and then incorporated into large-scale production.

The use of SAF is already reducing both the *CO_2 -related climate impact* and other *climate-impacting effects (e.g. through* contrails, so-called non-CO_2 effects). Research into the further optimization of SAF - and the transfer of this knowledge into fuel standards and kerosene specifications that are constantly being improved - shall go hand in hand with the further development of aircraft engines; fuel and turbine shall be optimally matched so that the environmental impact can be minimized. It is to be expected that aircraft engines will become significantly more efficient in the coming decades, meaning that state-of-the-art aircraft will require less and less fuel per ton kilometer of flight performance. Furthermore, the approval of fully synthetic fuels (100% SAF) is an important prerequisite for achieving climate neutrality and further improving flight performance through optimized turbines. (For example, Rolls-Royce has already tested all engine series currently in production with pure SAF.) In order to accelerate this positive development at the fuel-turbine interface, aireg is also increasingly calling for the realization of corresponding research projects aiming at cooperation between research institutions, SAF producers as well as engine and aircraft manufacturers.

Concepts for innovative and further improved process, plant and system technology for SAF production must also be developed and optimized. One key example is the synergetic ("hybrid") use of biomass and electricity or hydrogen from renewable sources, which offers promising potential for significantly reducing the costs of SAF in the longer term. Such joint use is particularly suitable for regionally generated waste and residual material streams and can therefore promote an economic ramp-up of SAF in Germany and Europe.

In addition, aireg promotes innovation, SAF technologies and corresponding business models by providing an ecosystem for SAF start-ups. In doing so, aireg supports inventors, founders and entrepreneurs in presenting innovative approaches, building a partner network and attracting private capital. aireg also promotes innovative approaches to the procurement of SAF raw materials in order to continuously improve the availability, cost and sustainability of these raw materials.

3.4 Policy - reassessment and increased promotion

aireg supports the active promotion of the SAF ramp-up by German and European policymakers on the basis of existing regulations in Germany, the EU and the ICAO. This includes *considerable, additional support measures for the SAF ramp-up, especially in Germany* and it particularly affects the ramp-up of PtL-SAF as part of an efficient design of the German energy transition (hydrogen economy as a cornerstone).

With the *"ReFuel-EU Aviation" regulation*, the EU has set specific minimum blending quotas for SAF in the EU from 2025 and beyond in order to promote the ramp-up of SAF throughout the EU. *However, there are considerable risks that these targets will be achieved without further political support*. In particular, there is a high risk that less mature SAF technologies such as PtL-SAF will not be commercially available in time. In the case of HEFA-SAF, the availability of sustainable raw materials is limited. In order to make these quantities available at low cost, corresponding global supply chains shall therefore be used quickly and sustainably. If this cannot be successfully implemented from a cost-efficiency point of view, the high costs of SAF today *(factor 3 to 10)* could have a strong negative impact on the competitiveness of European airlines, promote an unwanted and counterproductive shift of connections abroad and thus dampen the acceptance of airlines.

The expected changes in the increasing climate costs in aviation (e.g. due to EU ETS charges, aviation fees) and increasing customer acceptance of the use of SAF are not sufficient to compensate for the associated economic risks for SAF users; the comparative extra costs of SAF can lead to customer migration. Therefore, without further political incentives, there is a risk of a significant negative economic effect on earnings, which would severely inhibit the procurement of SAF by airlines beyond the mandatory quotas and thus a production ramp-up.

Accelerating the SAF ramp-up in Germany above the EU blending quotas is very challenging. However, it can be achieved by *mitigating the expected additional costs of SAF compared to fossil kerosene and potential bottlenecks in the procurement of raw materials through additional political measures*. This can create additional incentives for private investors to quickly make the considerable investments in new SAF plants or the conversion of existing refinery plants that are required in the near future. This can put Germany in a pole position, giving it an advantage in the subsequent further global market expansion (first mover, lighthouse or role model function).

aireg therefore supports a national and European policy that promotes the accelerated production of SAF in Germany and the EU beyond the quotas in ReFuelEU at internationally competitive conditions and ideally creates appropriate framework conditions at European and international level. For example, the interest of airlines in SAF (demand) could be increased through *multiple crediting of SAF produced in the EU in compliance with defined sustainability standards* (with reference to the direct improved climate effect, the social standards to be complied with and the innovation effect) in the calculation of ETS fees or national climate charges. This could quickly and directly increase the demand for SAF beyond the prescribed EU quotas and also link it to European value creation.

In particular, PtL-SAF is a fuel option with a high potential for reducing the climate impact of air traffic. With the development of a Germany-wide hydrogen economy, Germany has excellent conditions to become an international technology leader in hydrogen-based aviation fuels (PtL-SAF). For this to succeed, however, the *ramp-up of PtL-SAF* must be given *political support even more specifically.* First of all, the *existing research projects for PtL-SAF must be accelerated in* order to further improve the technologies for the production of PtL-SAF; for example, the already initiated funding of the "Power-to-Liquid Technology Platform" project in Leuna should be consistently driven forward.

With PtL-SAF as a technology having a comparatively lower level of maturity, it is to be expected that *the state will* have to *assume some of the technological and regulatory risks* in order to quickly offer private investors incentives to *scale up* production *to a commercial level*. *In line with the EU PtL quota and the aireg targets for the* PtL *ramp-up, aireg supports the rapid construction of a large-scale PtL SAF plant with a production capacity of 200,000 t/a in 2030.* In order to make the construction and operation of such a plant attractive to private investors, it makes sense to draw on instruments that have proven their worth in other sectors. For example, policymakers could provide for the *use of carbon* contracts for difference (CCfD) in conjunction with a tender for these SAF projects with duration of 15-20 years and thus create the necessary planning security; such projects are already being implemented today with the introduction of hydrogen as an energy source in the basic materials industry.

The use of carbon contracts for difference to *finance* SAF projects may require considerable governmental funding, which could be financed via a fund model. In principle, existing funds such as the Climate and Transformation Fund (CTF) or the EU Innovation Fund would be available for this purpose. The revenue described above from the regulation of CO_2 in aviation (ETS, possibly ETD, national fees/taxes) could be used to provide the necessary additional state funding.

The necessary rapid *ramp-up of currently available SAF technologies such as HEFA-SAF can* also be *supported by political measures.* As described in chapter 3.2 technologies such as co-processing in existing refineries using widely available and sustainable bio and waste materials play a key role here. *Barriers to the use of these technologies* should therefore be *removed as quickly as possible in accordance with EU law and the SAF mandate, and their use should be promoted in line with EU sustainability and verification criteria*.

Finally, policymakers shall also *create competitive framework conditions for the procurement of the necessary raw materials and pre-products for SAF (e.g. sustainable electricity, bio and waste mass, methanol or PtL syncrude)* so that the ambitious SAF targets can be achieved. SAF depends on favorable, often international procurement of renewable electricity, hydrogen and organic materials. These raw materials will be in short supply in foreseeable future, and supply bottlenecks are also to be expected in mid to long term, which could cause considerable price distortions.

In the context of the *national import strategy for hydrogen and derivatives* (see also H2Gobal), *explicit consideration of PtL-SAF* is necessary. For biogenic raw materials, it *makes sense* to *regularly review the raw materials approved in REDIII Annex IX in order to expand the sustainable raw material base for SAF as far as possible. Furthermore, the increasing use of raw materials for the local production of SAF in Germany should be given appropriate consideration in the National Biomass Strategy.* Since SAF is the decisive lever for air transport on the way to climate neutrality by 2050, *aireg recommends prioritizing air transport over other transport sectors that have alternative technologies*, especially road transport*, in the event of bottlenecks.*

4 Summary

The aim of aireg - Aviation Initiative for Renewable Energy in Germany e. V. - is to strive for the most climate-neutral and competitive aviation possible in Germany by using SAF and at the same time to establish Germany

as an international technology leader in the international future market for sustainable aviation fuels. As a competence network and transformation platform for all key stakeholders along the entire value chain, aireg is involved in four areas: recommendations for promotion of local SAF use, organization of local SAF production, supply as well as research and development and SAF regulation.

This paper justifies the urgency of a *rapid and sustainable market ramp-up of SAF in Germany* in order to achieve the international climate targets in aviation (net CO_2 neutrality by 2050) and to establish Germany and Europe as pioneers in international climate policy. SAF is generally seen as a decisive lever in international aviation for reducing CO_2 emissions as well as other climate-relevant effects associated with contrail formation. Currently, less than 1% of the required amount of aviation fuel worldwide is available as SAF; this necessitates the rapid, worldwide development of a SAF industry, which should happen without delay. Germany is in an excellent position to lead the development of a global SAF industry, thanks to its strong industrial base and its role as Europe's largest aviation market.

In order to achieve these targets, aireg is setting specific SAF utilization targets for Germany and developing joint strategic proposals (including air transport, SAF producers/industry, research, politics) to achieve these targets. In particular, this includes targeted promotion of PtL-SAF as part of the national hydrogen strategy and targeted support for all SAF production paths as a necessary prerequisite for exceeding the minimum SAF quotas adopted by the EU. The regulatory framework conditions specifically for the promotion and acceleration of research projects, industrial SAF pilot plants and the design of financial government incentives to further develop the technologies for the production of PtL-SAF and make them commercially available in good time must also be regularly reviewed and, if necessary, adapted.

Overall, the strategy paper underlines aireg's role in promoting a rapid ramp-up of SAF use in Germany. It illustrates the strong interest of its members from aviation and the respective upstream and downstream industries - and the corresponding research - in jointly shaping Germany as a leading market for SAF and the need for active, supportive government funding in order to achieve the ambitious targets for sustainable aviation and the development of technology leadership in the field of SAF.

5 Legal information

Germany as a leading market for sustainable aviation fuels (SAF) - Strategy paper

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